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VOL. 38

LOCKHEED'S FAMOUS
"MISSILE WITH A MAN IN IT"

F-104 STARFIGHTER

A DETAIL & SCALE AVIATION PUBLICATION

in detail & scale

Bert Kinzey

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Front cover: This highly polished F-104G belongs to the 69th Tactical Fighter Training Squadron, and was photographed at Nellis Air Force Base, Nevada, on October 3, 1980. (Flightleader)

Rear cover: Details and colors of the instrument panel in an F-104C are shown in this photograph that was taken by the author at the Air Force Museum.

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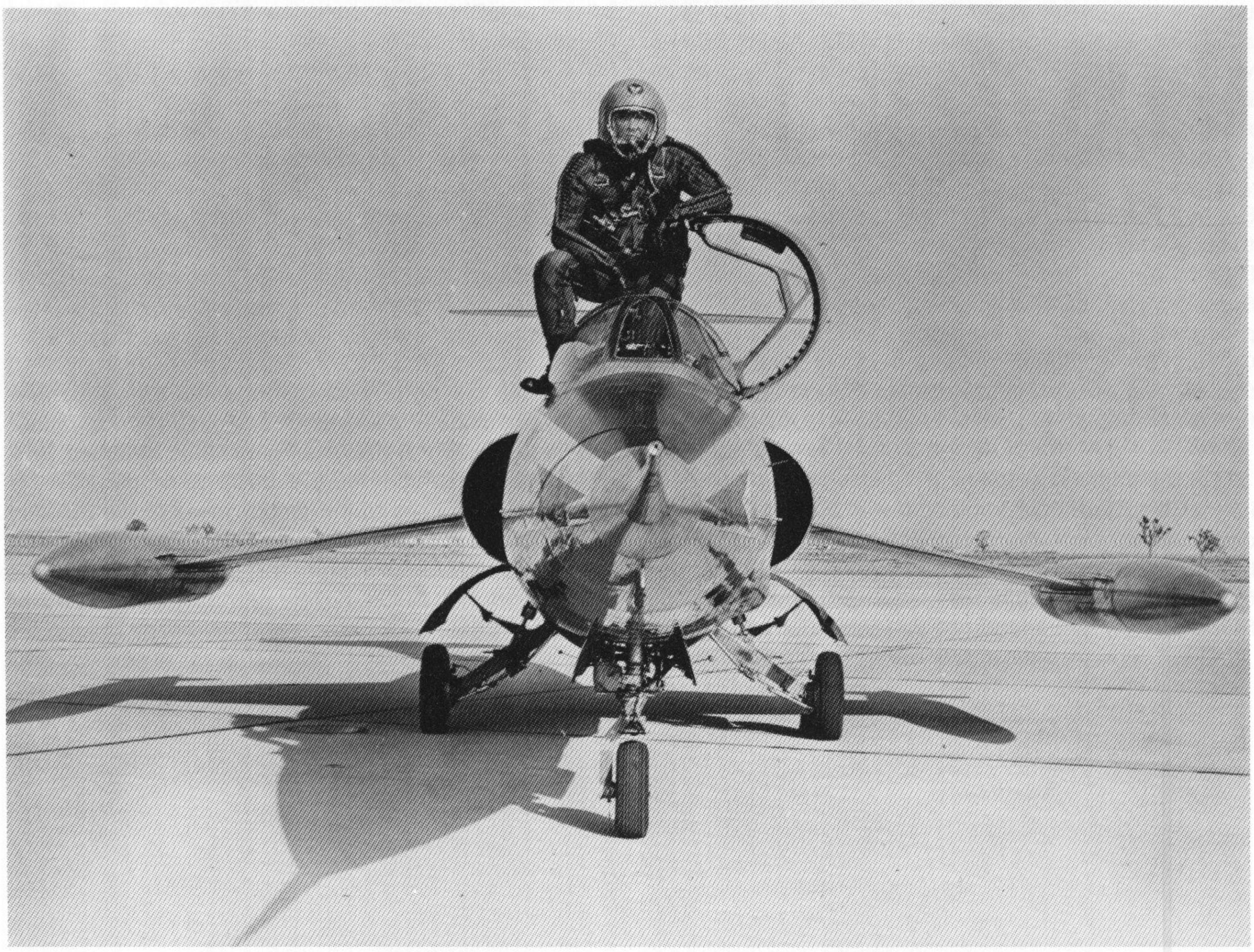
INTRODUCTION



This head-on view of one of the Starfighter prototypes illustrates many of the F-104's design features although it gives a somewhat distorted appearance. The pilot appears to be only a short distance behind the nose, when in fact he is fifteen feet back from the pitot tube. The small frontal area of the design is emphasized, as are the short, thin, stubby wings. Detail of the landing gear, its doors, and the coneless intakes of the prototype are also visible. The pilot is wearing the full pressure suit and helmet that was in vogue for USAF fighter pilots when the F-104 was first tested.

(USAF via Sullivan)

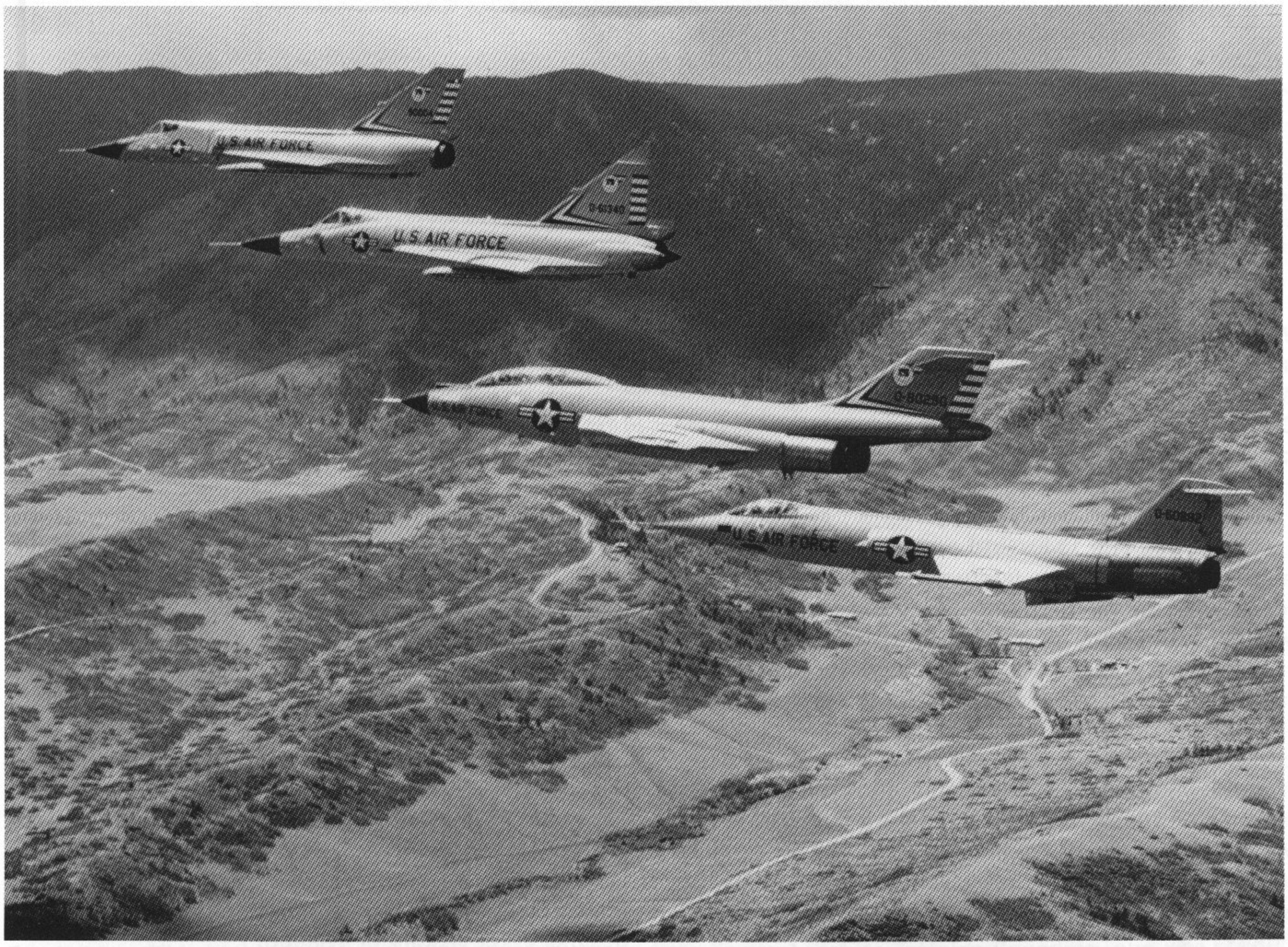
During the late 1940s and early 1950s, aeronautical engineers were trying to figure out the best wing design for aircraft that would fly faster than the speed of sound. It was a sure thing that existing straight wings with conventional airfoils would not be satisfactory. New designs for more streamlined swept and delta wings seemed to hold the keys, and although the first aircraft to break the sound barrier, the Bell X-1, had straight wings, it appeared that the designs for future supersonic aircraft would have wings with the sleeker swept or delta shape. While this would prove to be fact in most cases, in the early 1950s the straight wing was not completely dead, and would be used very successfully one more time on a supersonic fighter.

Lockheed has always been known for its unorthodox and unusual solutions for solving aerodynamic problems in all areas of aviation. Based on the experience with the experimental Douglas X-3 Stiletto, Lockheed's designers began work on a jet fighter that would answer the call from U.S. pilots in Korea for more speed and maneuverability. While other aircraft manufacturers worked with swept and delta wings, Lockheed developed a new tapered straight wing that became the talk of the industry. When their new fighter was rolled out and made public, almost all of the media information centered around its razor thin, short, stubby wings. It seemed like an aerodynamic impossibility that such a short thin wing could carry the fuselage and pilot, not to mention the engine, fuel, and weapons. In actuality, the leading edge of the wing was about as sharp as a table knife, not a razor, but it was so unique that it became one of the most talked about designs in the history of aviation.

Designated the F-104, named the Starfighter, and dubbed the "missile with a man in it" by the publicists and press, Lockheed's new fighter began what turned out to be a most curious operational life. Its service history became as unusual as its design. It was never really accepted in any great numbers by the U.S. Air Force, and was assigned to only one tactical fighter wing. Several interceptor squadrons with the Aerospace Defense Command used it for a relatively short period of time compared to the F-101B, F-102, and F-106, and it did serve with the Air National Guard in limited numbers as well. But the Starfighter, which was used in fewer numbers by the U.S. Air Force than any other Century Series fighter, became a huge success in Europe, Canada, the Middle East, and the Orient. Outside of the United States, it was produced and used in far greater numbers than any other Century Series fighter, and is the only one of these fighters that remains in front line use in the 1990s in the form of the Italian-produced F-104S.

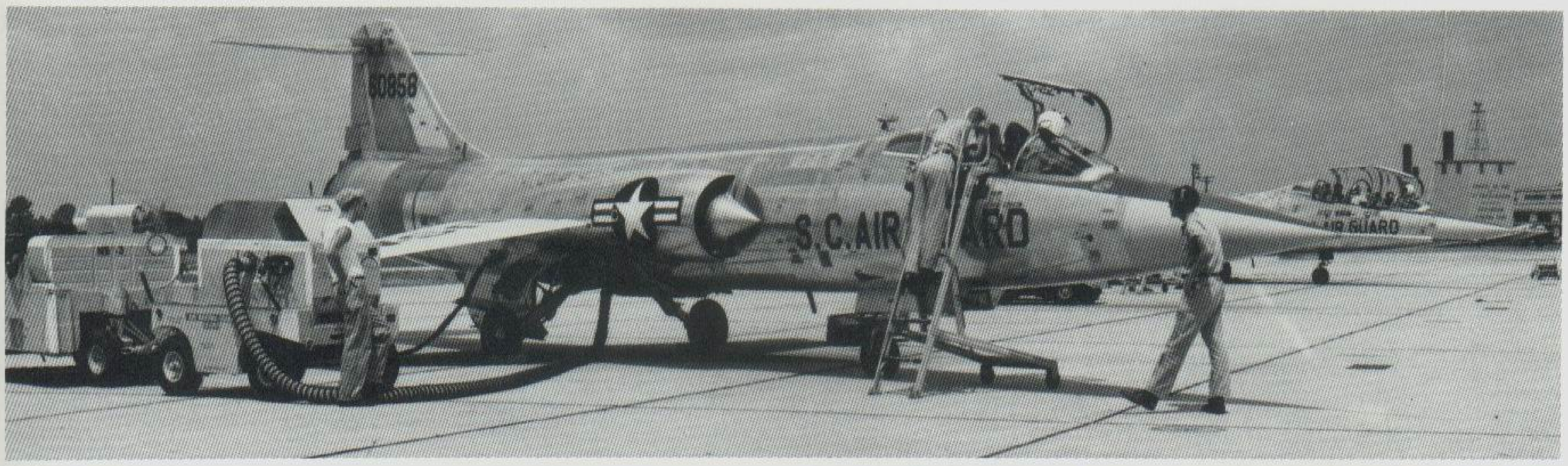
On the pages that follow is a close-up and detailed look at the Starfighter beginning with a summary of its developmental history. Then each version is discussed beginning with the XF-104 prototypes. This publication focuses primarily on the versions used by the U.S. Air Force, but foreign variants are also illustrated and briefly discussed. Differences between the versions are pointed out in the narrative, photographs, and captions. Five-view drawings in 1/72nd scale were drawn specifically for this publication by Dana Bell, and scores of photographs illustrate the many features of the Starfighter. Cockpit detail, the radar, ejection seats, different canopies, landing gear, intakes, and wing and fuselage details are all illustrated with scores of photographs, most of which were taken specifically for this publication by the author. Our usual Modelers Section covers the many kits of the F-104 that have been released since the 1950s, and lists the available after-market decals that can be used with them.

During the preparation of this publication, several trips were made to do research and obtain photographs. The cooperation of many people should be noted, and the names of all contributors are listed on page two. A special thanks goes to Mr. Geoff Hayes of the U.S. Air Force Museum, and Mr. David Menard. The author also expresses his appreciation to Mr. Bill Paul for providing access to the F-104A at the Museum of Aviation at Robins Air Force Base, Georgia.



After being accepted by the Air Defense Command as an interceptor, an F-104A joins with the three other interceptors of the Century Series of fighters. From left to right are an F-106A Delta Dart, an F-102A Delta Dagger, an F-101B Voodoo, and an F-104A Starfighter. All but the F-104 wear markings of the Air Defense Weapons Center at Tyndall Air Force Base, Florida. ***(USAF via Haynes)***

DEVELOPMENTAL HISTORY



The F-104 saw limited service with the U.S. Air Force in the Air (Aerospace) Defense Command, the Tactical Air Command, and the Air National Guard. This is an F-104A in the markings of the 157th Fighter Interceptor Squadron which is a part of the South Carolina Air National Guard. The photograph was taken in 1961 at McEntire ANGB, South Carolina. In the background is one of the unit's two-seat F-104Bs. (Taylor collection)

When the early biplanes and triplanes of World War I engaged in history's first fighter-versus-fighter aerial combat, it was clear from the outset that the aircraft with the greater speed and maneuverability held the advantage. Improving these two capabilities became the primary goals of new fighter designs, and for years, a fighter's primary mission was to successfully engage the enemy's fighters. Its ability to attack ground targets was usually a secondary consideration by a substantial margin.

As the struts and fabric of the biplane gave way to the metal monoplane, the primary mission of the fighter did not change. In World War II, the most important function of fighter aircraft was that of winning air superiority over the enemy. This was usually accomplished in the great fighter battles in the skies over Europe and in the Pacific. The classic one-on-one dogfight was the glamorous and celebrated style of aerial combat, and the aces of all countries became national heros. But fighters were also used for two other very important missions. One of these was protecting the homeland, armies in the field, and ships at sea from bombardment by enemy bombers. In the role of interceptors, fighters rose to challenge the bombers and hopefully destroy them before they could unleash their weapons against the homeland or important military assets. Fighters became equally as important as the anti-aircraft guns on the ground or on the ships at sea. Often, they were even more valuable as defensive weapons, and in some cases, they provided the only defense against enemy air attack.

The third role that was given to the fighter in World War II was that of attacking the enemy on the ground. Although fighters had been used to perform this mission in World War I, it was rather limited in scope. Even in World War II, most fighters had a very limited capability to attack ground targets. Usually, no more than two bombs of comparatively small size could be attached to hardpoints under the wings or fuselage that were normally used for carrying fuel tanks. Eliminating the external tanks and adding the weight and drag of the bombs left most fighters with very little range in the ground attack role while carrying such external ordnance. Rockets were also carried on single rails or in multiple launch tubes, but it was often a fighter's machine guns that were its main weapons against targets on the ground. As air superiority was gained over Germany, fighters were used more and more against targets on the ground. As allied fighter strength continued to grow and the Luftwaffe became less active, there were less targets in the air. In the later months of the war, when allied fighters ranged far and wide over Europe to attack the German army and Luftwaffe on the ground, there was a continual shift in fighter missions from fighting Germany in the air to fighting Germany on the ground.

Although fighter aircraft proved their worth in a variety of missions in World War II, the aircraft themselves and the weaponry were not sophisticated enough to dictate that fighter design be specialized to optimize the aircraft for one mission or another. A P-51 Mustang or an F6F Hellcat, designed primarily to defeat enemy fighters in the air, could also be used to strafe targets on the ground or on the sea. If needed, bombs or rockets could be carried as well, but that was really as far as it went for the most part. When attacking surface targets had to be a really serious business, it was left to the dive and torpedo bombers of the Navy, and the attack, medium, and heavy bombers of the Army Air Corps.

The jet age arrived soon after World War II, and the first jet-versus-jet combat ensued shortly thereafter. One thing that hadn't changed was that speed and maneuverability in aerial combat was just as important in a jet as it had been in a biplane. When the MiG-15 appeared in the skies over Korea, its capabilities surprised many western observers. The MiG-15 was clearly superior to the straight-wing F-80 Shooting Star and F-84 Thunderjet in the U.S. Air Force, and the F9F Panther and F2H Banshee in the Navy. The MiG's superiority over these fighters was due to its clear advantages in speed and maneuverability. The only operational U.S. fighter at the time that could combat the MiG-15 on better than equal terms was the

North American F-86 Sabre, an air superiority fighter in the classic sense of the word like the P-51 Mustang before it. But the twelve-to-one kill ratio enjoyed by the F-86 over the MiG-15 was more a factor of pilot skill than aircraft preeminence. The American pilots in Korea expressed their concern and desires for an air superiority fighter with better speed and maneuverability, and there was someone ready to listen.

Clarence L. (Kelly) Johnson, Lockheed's most famous aircraft designer, traveled to Korea to hear what the pilots had to say. Among what he heard were complaints that the F-86 was heavier than the MiG, and that some of its gadgets were not worth their weight. What the pilots wanted was a simple lightweight fighter with the best possible speed and maneuverability. In short, the pilots wanted to trade weight and complexity for greater speed and maneuverability. After gathering his information, Kelly Johnson returned home to continue work on just such a fighter. Lockheed's engineers had been thinking along the same lines as the pilots, and had been working on a simple, lightweight fighter with great speed and maneuverability.

Basing much of their design concepts on their earlier but aborted F-90 and the Douglas X-3 Stiletto, the design team at Lockheed had developed a revolutionary and unique design for the new fighter. By November 1952, they submitted an unsolicited proposal to the Air Force. The projected aircraft would be relatively small, lightweight, and have a straight wing that was short in span and very thin. This last feature was directly related to the design of the X-3 aircraft. It was known as design L-246 at Lockheed, and was assigned the manufacturer's model number 83. Although the Air Force was in the market for a new air superiority fighter, they had envisioned a fighter that was considerably larger, heavier, and probably having a delta wing. But there was one additional feature of the Lockheed proposal that was most tempting. Its price tag was less than what the Air Force was expecting the new fighter would cost.

On December 12, 1952, the Air Force issued General Operational Requirements for the development of a lightweight air superiority day fighter. The following month, the Air Force considered hastily-prepared proposals from Republic and North American, as well as Lockheed's unsolicited proposal, and they announced that Lockheed's entry was the winner. The decision was due in part to Lockheed's head start in developing its proposal, and also because the other two companies were already involved in other fighter programs. North American was producing the F-86 Sabre and was developing the F-100 Super Sabre, while Republic was working on the F-103 and the F-105 Thunderchief.

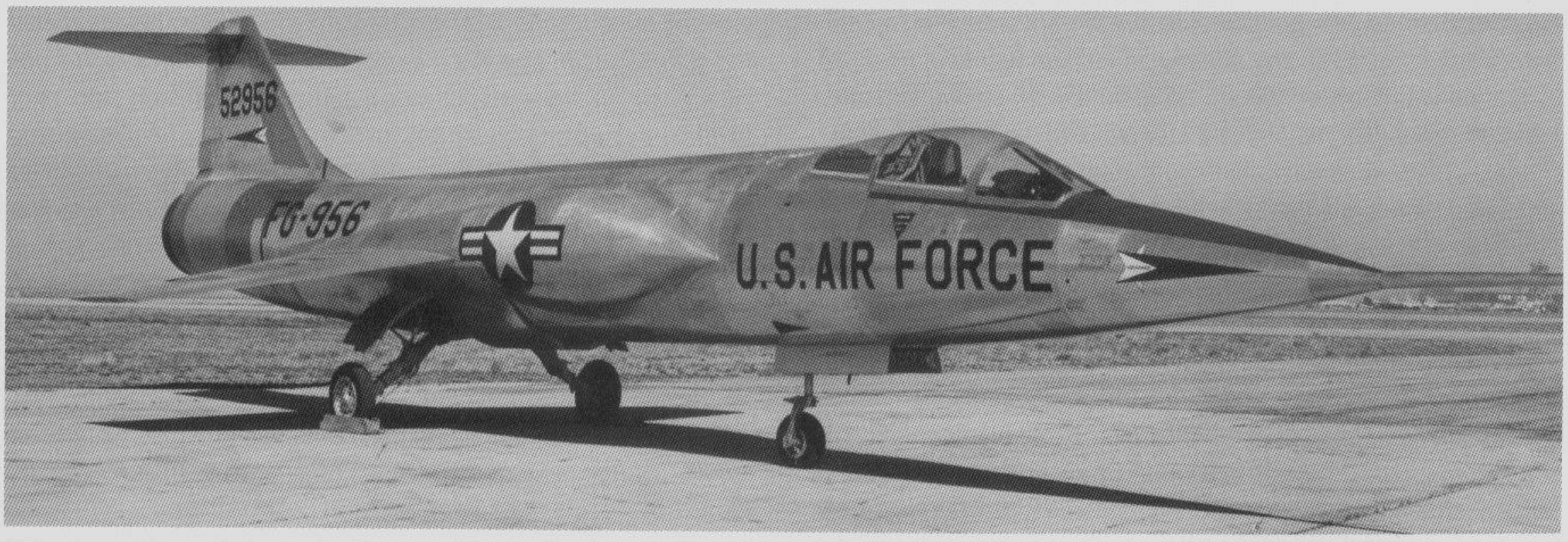
A letter contract was given to Lockheed on March 11, 1953, and it called for the construction and flight testing of two XF-104s. The mock-up inspection was conducted on April 30, 1953, and resulted in several minor changes. Among these was the replacement of the two 30mm cannons with a single 20mm Vulcan cannon. The development of the aircraft continued at a fast pace, and the first flight of the initial prototype occurred on February 28, 1954, less than one year after the letter contract was delivered to Lockheed. However, this initial "flight" was something of an accident, when the aircraft became airborne on a high speed taxi run. The first intended flight was made on March 4, 1954, with A. W. (Tony) LeVier at the controls.

When the XF-104 was ready to fly, the General Electric J79 engine was not, so the two XF-104s were powered by the less capable Curtiss-Wright J65 engine. But the flight tests looked promising, so, in July 1954, the Air Force ordered seventeen YF-104As to continue the flight test program. Any future production of the aircraft would be based on the success of the flight test program conducted by these aircraft. Once the tests were completed, the Air Force planned to bring these aircraft up to production standards and place them in operational use.

On April 14, 1955, one of the XF-104s was destroyed in a crash when the Lockheed test pilot was forced to eject as a result of a gun explosion. But testing with the second aircraft had demonstrated a speed of Mach 1.7 even with the J65 engine. With the J65, the Starfighter was already flying faster than the other Century Series fighters being developed at that time. Its ceiling was 60,000 feet, which was about 7,000 feet higher than expected. Flight testing had proven that the estimates on performance were accurate, and the XF-104 was two to three percent better than its projected drag and speed figures. Other supersonic aircraft that were being tested at the time had failed to meet their estimates by considerable margins.

The second XF-104 was also lost in a crash on July 11, 1957, after accumulating over 1,000 flight hours. The crash was caused by a structural failure resulting from a fuselage fuel tank cap coming off and striking the vertical stabilizer. Test pilot William Parks, Jr. ejected successfully.

In order to gain the best thrust-to-drag ratio, the F-104's wing had been made as small and as thin as possible. Span was 21.9 feet, but this included the fuselage as well. The fact that each wing was only seven and one-half feet from root to tip provides a better understanding of how small they were. It was only 4.2 inches thick at its thickest point next to the fuselage at the root. At its tip, it was less than two inches thick at its center. The straight tapered wing design with a low aspect ratio was more efficient than a delta wing, because it had a significant reduction in drag. While it is true that each square foot of a delta wing has less drag in the transonic speed regime than that of a straight wing, the low-lift capability of a delta wing during landings and takeoffs requires twice the total area of a straight wing. Therefore a much larger delta wing is required, and the result is that total drag of the delta wing is much greater. Thus, the small straight wing coupled with the F-104's light weight resulted in the best possible thrust to weight and thrust to drag ratios. This produced the high supersonic speeds even with the temporary J65 engine.



This view of the second YF-104 illustrates the fact that the nose landing gear was moved to the aft end of the well. XF-104s had their nose gear at the forward end of the well. Again the intakes are covered with a blended sheet metal cone for security reasons. ***(USAF via Jones)***

Other design features included a high vertical tail with an all-flying horizontal tail at the top in what is known as the "T" tail configuration. Because the vertical tail extended above the center of gravity about as much as the wings extend to each side, the vertical tail produced a large dihedral effect in sideslip maneuvers. Therefore, the wings were mounted at a ten-degree anhedral or downward angle to the fuselage.

Throughout the design there was an attempt to save weight. Because the wings were so thin, ice could not build up on their surfaces, so no deicing equipment was needed. A new lighter electronics systems was conceived and installed as a series of inter-connecting but self-sustaining units. As a result of the weight limiting efforts, the empty weight was about half that of other fighters. This helped increase the thrust-to-weight ratio and, therefore, increased the speed of the aircraft. The simplicity of the design and its components resulted in cost savings, and it was expected that the F-104A would cost about half what other fighters were going to cost. While this meant that twice as many F-104As could be produced for the same amount of dollars, this had to be weighed against the capabilities of each aircraft when it came to factors such as the ability to operate in all weather conditions, the amount and types of ordnance that could be delivered, and the avionics and ground control equipment that could be installed.

On February 17, 1956, the first YF-104 was flown, and it differed from the two XF-104s in that it had a lengthened fuselage, shock cones in its redesigned intakes, and a nose gear strut at the aft end of its well rather than at the front as it had been on the XF-104s. The YF-104 also had a fairing along its spine from the canopy to the vertical tail, but otherwise, very little was changed externally between the XF-104 and YF-104. Boundary layer control was added to the production aircraft to provide greater lift at lower landing speeds. High-velocity compressed air was piped from the engine and blown from a slotted tube over the upper surface of the trailing edge flap. This "tricked" the flap into thinking it was flying faster than it actually was, and resulted in greater lift. The blown air smoothed out the air flow over the wing and held it to the surface even at high angles of attack.

With the General Electric J79-GE-3A installed, the F-104 became a double-sonic aircraft, and it was the first jet aircraft to exceed Mach 2 in level flight. But recurring engine problems caused the F-104 to be grounded on several occasions. Finally, in 1958, the J79-GE-3A was replaced with the improved and more reliable -3B engine.

General Electric was also developing the M-61 Vulcan cannon for the F-104 and other aircraft, and here again there were problems. Production F-104As went into service without the cannon installed, and it was 1964 before these aircraft were retrofitted with cannon armament.

Impressed with the F-104s performance and low cost, the Air Force had gradually increased the number of F-104As that it intended to buy. In 1957, the programmed production stood at 610 F-104As, but then the entire F-104 program was slashed, and only 170 were produced. This was due in part to the ever-present funding shortages faced by the military, but was also because of a change in thinking within the Air Force. In short, the Air Force had redefined the fighter, and the classic air superiority fighter in the tradition of the P-51 and F-86, had, at least for the time being, became a thing of the past. Many years later, and after the lessons learned in Vietnam, the F-15 Eagle would be designed in the mold of the air superiority fighter, but in the mid-1950s the Air Force's concept of the fighter was changing.

The new thinking called for two distinctly different types of fighters designed and optimized for specific missions. One of these was the fighter-interceptor that would be designed to intercept and shoot down enemy bombers in defense of the United States. The Air Force was concerned about the possibility of even a single bomber penetrating the skies over the United States and dropping a nuclear bomb. It was believed that a traditional fighter that was armed with machine guns could not insure destruction of enemy bomber forces. Instead, a fighter-interceptor specifically designed for the job was needed. Such an interceptor would be armed with rockets and/or guided missiles to insure destruction of the bomber. These air-to-air weapons would best be carried internally to reduce drag on the aircraft. In short, a fighter interceptor would have no capability to attack a target on the ground. The interceptor would be radar equipped to allow operation day or night and in all kinds of weather, and its avionics and other electronic systems would be optimized for air-to-air delivery of its weapons. Further, it would have data links to ground control equipment that would allow it to be controlled from the ground so that all interceptors could be directed to the incoming bombers in a coordinated defensive attack. These fighter interceptors would be assigned to the Air Defense Command's fighter interceptor squadrons. By the mid-1950s, the F-101B, F-102, and F-106 fighter interceptor programs were well underway in an effort to replace the earlier F-86D, F-89, and F-94 interceptors.

The second type of fighter that the Air Force wanted was the fighter-bomber. With avionics and weapons optimized to attack ground targets, the fighter-bomber aircraft would retain varying degrees of capability to engage in air-to-air combat against enemy aircraft as needed. But their primary mission was to deliver conventional and nuclear weapons against targets on the ground. The fighter-bombers were assigned to the tactical fighter wings of the Tactical Air Command. The F-100 Super Sabre and the F-105 Thunderchief were destined to be TAC's fighter-bombers when the F-104 was ready for production.

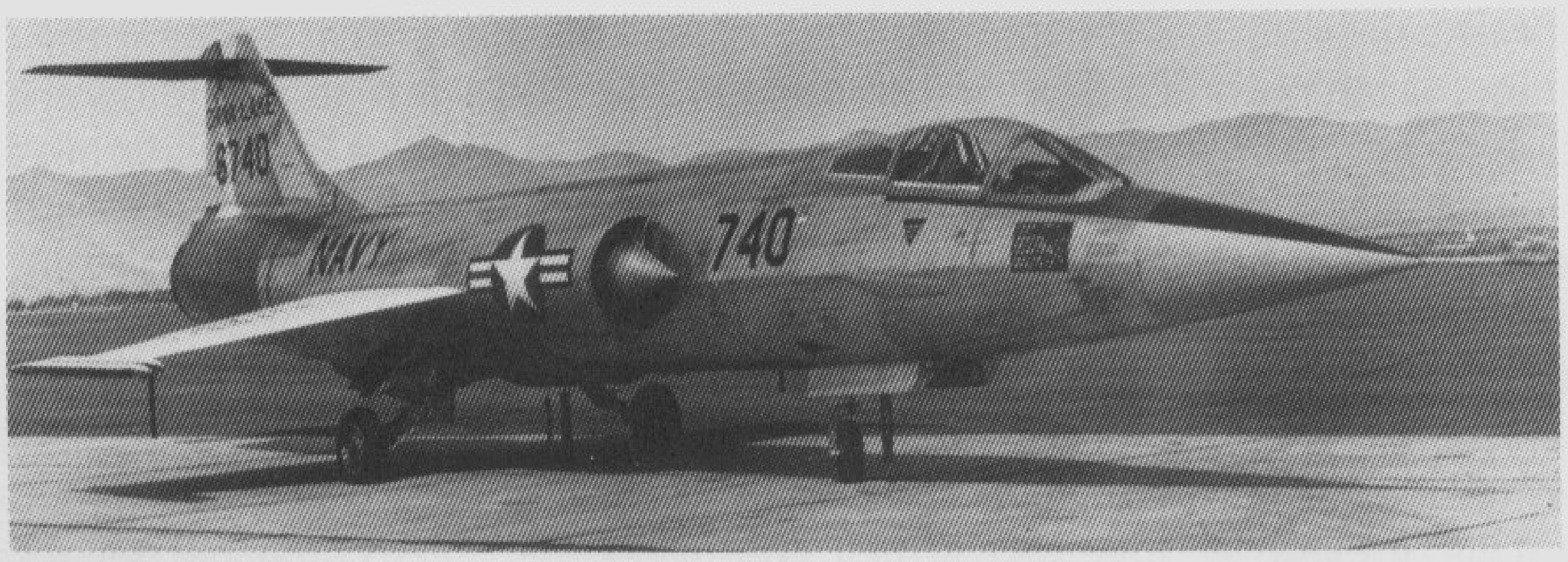
This concept concerning mission-oriented fighters did not happen overnight. It had developed over the years, both operationally and conceptually. Early interceptors and fighter-bombers were already in the inventory in addition to the air superiority F-86. But again, budget constraints meant that the Air Force could not have everything it wanted, so something had to go. The Air Force believed that the classic one-on-one fighter combat of years past would become almost obsolete in the atomic age. Although the Vietnam experience would prove this to be untrue, and would underscore the need for an air superiority fighter, the F-104 Starfighter became a casualty of the thinking and realignment of the Air Force in the 1950s.

Kelly Johnson had designed the F-104 to be a lightweight air superiority fighter, and just when it was ready for production, the Air Force had decided that it did not need nor could it afford such a fighter. Since it had very limited capability to attack ground targets, TAC rejected the F-104, but ADC thought it could put the aircraft to interim use. The primary interceptor at that time was the F-102, and it was barely supersonic. With external fuel tanks, the Delta Dagger could not exceed the speed of sound. The F-101B was faster, but could carry only two conventional AIM-4 Falcons and two Genie rockets with nuclear warheads. The F-106 program was way behind schedule at that time, so the F-104A with its impressive performance seemed to be an alternative until the F-106 could become operational in large numbers.

The F-104A entered service with the 83rd Fighter Interceptor Squadron at Hamilton AFB, California, on February 20, 1958. The problems with the Vulcan cannon had not yet been solved, so the F-104A became operational with no internal armament. Instead, the Air Force fitted the Starfighter with two AIM-9 Sidewinder missiles. These heat-seeking air-to-air missiles had been developed by the Navy, and had already been evaluated by the Air Force on the F-100. They were the only armament carried by the F-104As during their initial service with ADC. Initially, only four fighter interceptor squadrons operated the F-104A, and these had turned their Starfighters over to the Air National Guard by mid-1960. A second term of service with ADC began in 1963, but only two squadrons were involved.

In order to give the Starfighter increased ground attack capability, the F-104C was developed. It was provided with an in-flight refueling probe, and a centerline hardpoint to carry a nuclear store. The pylons under the wings could carry bombs or rocket pods in addition to the external fuel tanks carried by the F-104A. But compared to the F-105 Thunderchief, the ordnance load that could be carried by the F-104C was light, and its avionics were far less sophisticated. As a result, the F-104C served with only the 479th Tactical Fighter Wing at George Air Force Base, California, and only seventy-seven were built.

Although the Starfighter was a lightweight and rather unsophisticated fighter that went against the trend of increasing complexity, it was not a simple aircraft to fly. Its small wing and other characteristics made it most unforgiving, and crashes plagued its entire operational life. It was apparent to the Air Force that a two-seat trainer was required, and the F-104B was ordered into produc-



The performance of the F-104 was remarkable, and the Navy used three Starfighters at China Lake during 1959 for high altitude air-to-air tests. Here is an F-104A from the first production batch in Navy markings.
(Bowers via Menard)

MAIN DIFFERENCE TABLE

	A AF-56-748 THROUGH AF-56-882	B AF-56-3720 THROUGH AF-56-3724 AF-57-1294 THROUGH AF-57-1313	C AF-56-883 THROUGH AF-57-930	D AF-57-1314 THROUGH AF-57-1334
CREW	ONE	TWO	ONE	TWO
ENGINE	J79-GE-3B J79-GE-19, J79-GE-11A OR J79-GE-11B	J79-GE-3B J79-GE-19, J79-GE-11A OR J79-GE-11B	J79-GE-7A	J79-GE-7A
POWER RUDDER	NO	YES	NO	YES
NOSE GEAR	RETRACTS FORWARD	RETRACTS AFT	RETRACTS FORWARD	RETRACTS AFT
REFUELING PROVISIONS	GRAVITY FILLING	GRAVITY FILLING	PRESSURE TYPE SINGLE-POINT AND AIR REFUELING	GRAVITY FILLING ON UNMODIFIED AIRCRAFT. PRESSURE TYPE SINGLE-POINT AND AIR REFUELING ON MODIFIED AIRCRAFT (503 C/W)
OXYGEN SYSTEM	5 LITER LIQUID WITH PRESSURE SUIT CONTROL PANEL AND MD-1 PRESSURE DEMAND REGULATOR	10 LITER LIQUID WITH PRESSURE SUIT CONTROL PANEL AND MD-1 PRESSURE DEMAND REGULATOR	5 LITER LIQUID WITH PRESSURE SUIT CONTROL PANEL AND MD-1 PRESSURE DEMAND REGULATOR	10 LITER LIQUID WITH PRESSURE SUIT CONTROL PANEL AND MD-1 PRESSURE DEMAND REGULATOR
ARMAMENT	ONE 20-MM GUN	TWO AIM-9B MISSILES	ONE 20-MM GUN	

tion. This variant was essentially a two-seat F-104A, with the space for the cannon and a portion of the internal fuel capacity being used for the rear cockpit. Originally, 112 F-104Bs were ordered, but like the cutbacks with the F-104A and F-104C, only twenty-six were eventually produced.

The second two-seat Starfighter was the F-104D, which was based on the F-104C. It had the F-104C's in-flight refueling capability added, and could carry some of the same external stores. Like the F-104B, it carried no cannon armament, and a portion of the F-104C's internal fuel capacity was deleted. As a result, both the F-104B and F-104D were usually seen with external fuel tanks on the wing tips. Only twenty-one F-104Ds were built.

From a pilot's point of view, a major design problem with the Starfighter was its downward ejection seat. Fearing that a conventional upward ejection seat would not clear the high "T" tail of the aircraft, Lockheed's designers had opted for the seat to eject downward. But this meant that ejection could not be safely accomplished during takeoffs and landings or whenever the aircraft was operating close to the ground. After a considerable number of fatalities resulted from the use of the seat, the F-104 was retrofitted with a rocket-propelled upward ejection seat. The USAF and several foreign countries opted for the C-2 seat, while the German Air Force chose a seat by Martin-Baker. (See page 45.)

Although the Air Force expressed relatively little interest in the F-104 from an operational standpoint, its performance could not be ignored. A Starfighter piloted by Major H. C. Johnson captured the world altitude record with a climb to 91,249 feet on May 7, 1958. On May 17 that same year, Captain W. W. Irwin set a new speed record of 1,404.9 miles per hour. In all, seven time-to-climb records were set on December 18, 1958, as follows:

3,000 meters (9,842 feet)	41.85 seconds
6,000 meters (19,684 feet)	58.41 seconds
9,000 meters (29,527 feet)	1 minute, 21.14 seconds
12,000 meters (39,370 feet)	1 minute, 39.30 seconds
15,000 meters (49,212 feet)	2 minutes, 11.10 seconds
20,000 meters (65,616 feet)	3 minutes, 42.99 seconds
25,000 meters (82,020 feet)	4 minutes, 26.03 seconds

The F-104 was also the first jet aircraft to exceed 100,000 feet in altitude, establishing an altitude record of 103,395.5 feet on December 14, 1959. In doing so, it set a time-to-climb record to 30,000 meters (98,424 feet) in 5 minutes, 4.92 seconds. It became the first and only aircraft ever to hold world records for speed, altitude, and time-to-climb, simultaneously.

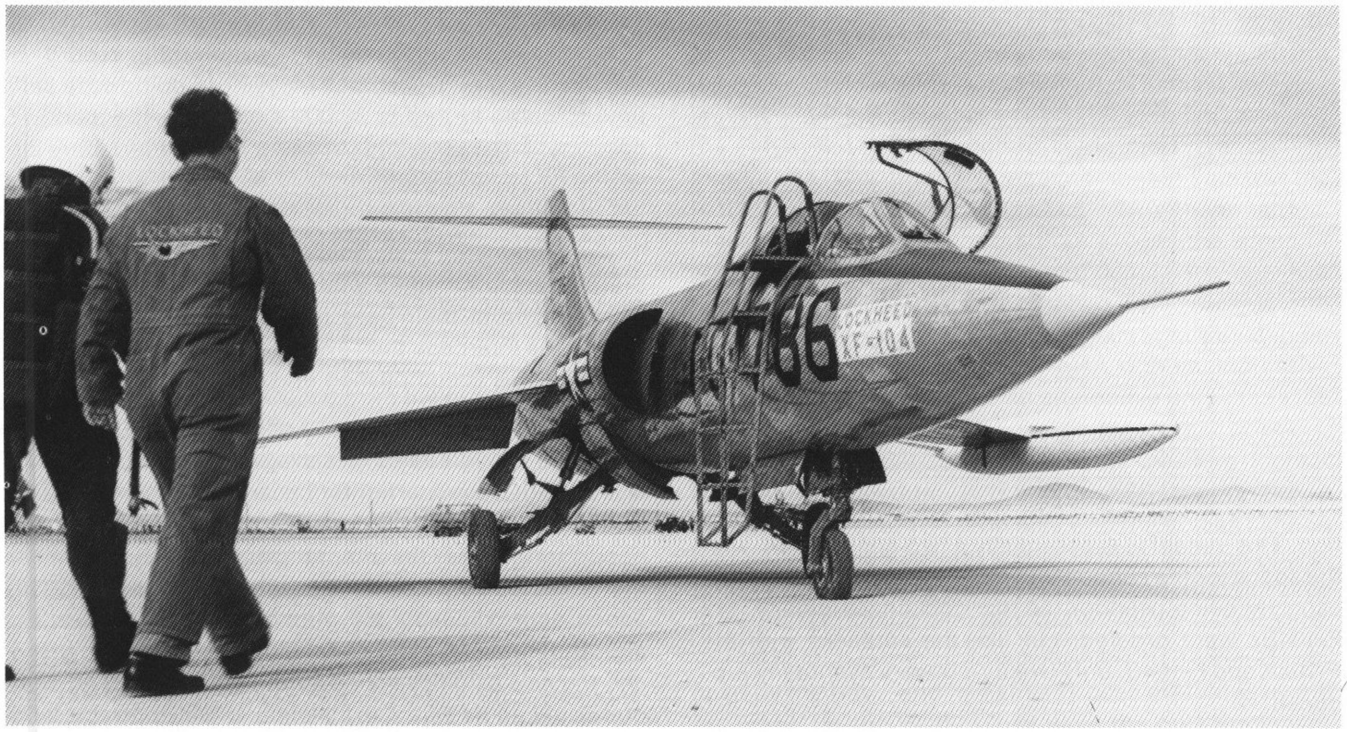
To demonstrate its quick intercept capability, two Starfighters intercepted a target flying at 35,000 feet and 172 miles from their base in 8 minutes, 59.9 seconds. During the intercept, they averaged 1,150 miles per hour. This feat was accomplished on December 10, 1958.

With very limited sales to the U.S. Air Force, Lockheed looked to foreign sales to salvage its F-104 program. It was here that the Starfighter became a huge success for Lockheed. In order to interest foreign customers, Lockheed strengthened the internal structure of the aircraft so that it became more effective as a fighter-bomber. This added approximately 350 pounds to the weight of the aircraft. The all-weather capabilities were also increased, and the new avionics added another 650 pounds. A more powerful engine was also installed. Initial contracts were signed with West Germany on March 18, 1959, and resulted in the production by Lockheed of sixty-six F-104Gs and thirty two-seat F-104Fs. By the end of 1961, agreements with West Germany, Belgium, The Netherlands, Italy, Canada, and Japan authorized these countries to produce the Starfighter abroad. By August 1962, F-104s were being built in seven countries and three continents. All of the single-seat aircraft produced by these countries were based on the F-104G design, which featured a larger vertical tail and rudder than was used on the F-104A and F-104C. It was the same tail that had been used on the F-104B and F-104D two-seat variants. An RF-104G reconnaissance version was also built, and it deleted the cannon armament in favor of three KS-67A cameras. The F-104F was a two-seat version similar to the F-104D, but built for the German Air Force by Lockheed. The other two-seat versions were the TF-104G, which was based on the F-104G single-seat version, and the F-104DJ, which was the Japanese two-seat variant of the Starfighter. The Canadian Starfighters were designated CF-104 and CF-104D for the single and two-seat versions respectively.

By the mid-1960s, the Starfighter was in use with more air forces and in greater numbers than any other U.S. designed fighter. The final design development was the F-104S that was built in Italy and used by both the Italian and Turkish air forces. The first production F-104S made its initial flight on December 30, 1968.

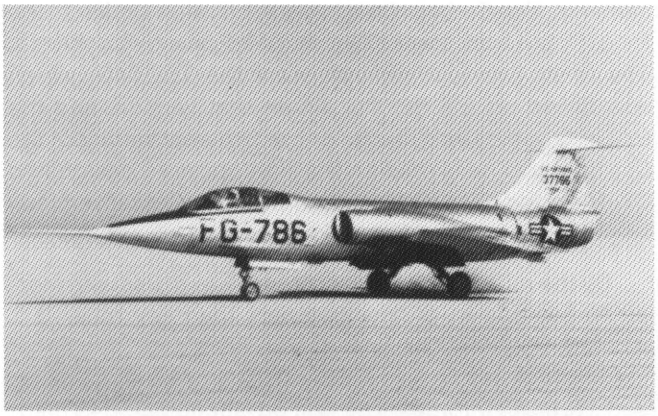
Although used in fewer numbers than any other Century Series fighter by the U.S. Air Force, it was by far Lockheed's most successful fighter design when the foreign sales and licensing were considered. On the pages that follow is a more detailed look at the various versions of the Starfighter.

XF-104



The pilot and a member of the ground crew head for the first XF-104 prototype in preparation for a flight. The Starfighter design differed from other U.S. fighters in that entry to the cockpit was from the right side of the aircraft instead of the left. Note the early boarding ladder, and the fact that the nose landing gear was at the forward end of the well on the prototypes. ***(Lockheed via Jones)***

Only two XF-104s were built and were given the model number 083-92-01. These two aircraft were assigned the serial numbers 53-7786 and 53-7787. Since the General Electric J79 engine was not ready when the airframe was, these two aircraft were powered with a Wright J65 engine that produced 7,800 pounds of thrust in military power and 10,200 pounds of thrust with the afterburner operating. The maximum speed of the J65-powered XF-104 was Mach 1.79.



The first XF-104 begins its takeoff roll at Edwards Air Force Base, California. Note the unusual placement of the buzz number on the forward fuselage, and the national insignia aft of the wings. The shorter fuselage of the XF-104 is evident, as is the lack of a fairing on the spine. Also note the intake and nose landing gear details. ***(USAF)***

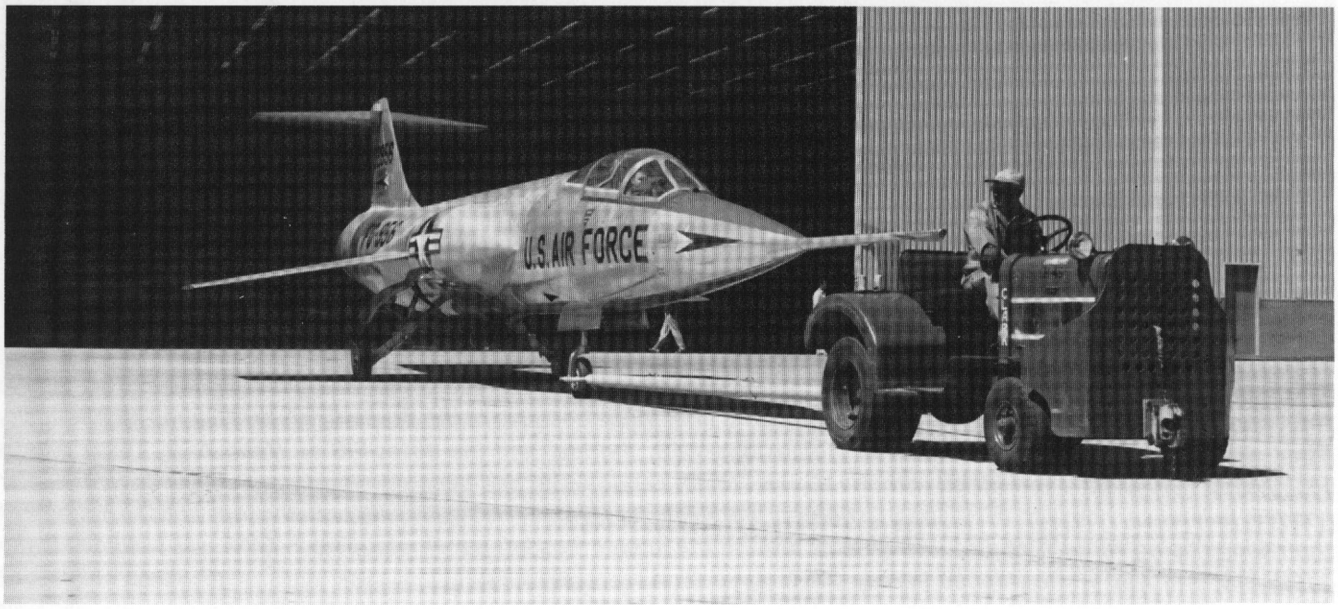
The two XF-104s were shorter than the subsequent production versions, being only 49.17 feet in length. All production aircraft were 54.77 feet in length. All other major dimensions remained the same as for production aircraft, as shown in the table on page 41. The empty weight of the XF-104 was 11,500 pounds, and it had a takeoff weight of 15,700 pounds.

The nose gear on the XF-104s was located at the forward end of the well, and the intakes were separated slightly from the fuselage. There was no shock or intake cone in the intakes of these two aircraft.

The flight test program conducted by the XF-104s was quite successful, and resulted in several refinements to the design of the aircraft. Unfortunately, both XF-104s were lost in crashes, but neither were related to flaws inherent in the aircraft or its design. The first crash resulted from a gun explosion on April 14, 1955. The second crash occurred on July 11, 1957, and was due to an unsecured fuel cap going off in flight and causing structural damage to the vertical tail. In each case, the test pilot ejected successfully. By the time the second aircraft was lost, flight testing was well underway with the YF-104As.

In spite of the fact that the XF-104s were powered with the J65 engine, the performance was impressive enough that the Air Force was prompted to order seventeen additional aircraft as YF-104As. These are discussed on the following page.

YF-104



The second YF-104 is rolled out of Lockheed's plant with the false cone-shaped fairings over the intakes. The nose gear has been moved to the aft end of the well on the longer YF-104 airframe. Very little in the way of changes were made to the Starfighter's design after refinements to the XF-104 were implemented in the YF-104. (Lockheed)

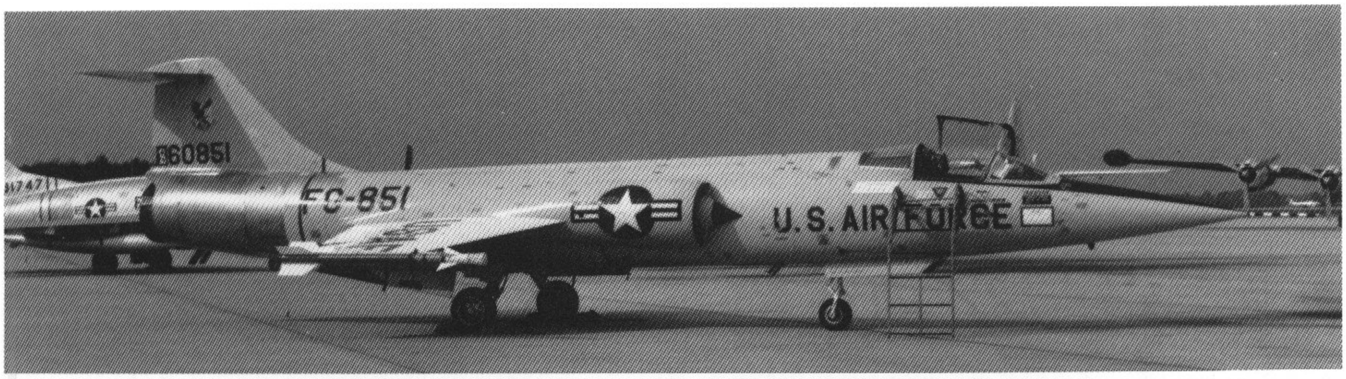
The first YF-104 climbs high over the California desert during testing. (Lockheed via Jones)

With the success and impressive performance of the two XF-104s, the Air Force ordered seventeen more aircraft in June 1954. They were assigned the serial numbers 55-2955 thru 55-2971. It was intended that these aircraft would incorporate changes based on the flight testing of the XF-104s, and these seventeen aircraft were originally designated YF-104As. Some of these aircraft even had this designation painted on their nose sections, but the Air Force had intended that this initial production block be brought up to F-104A standards and integrated into operational units. Therefore, the "Y" was subsequently dropped from the designation.

There were several noticeable physical differences between the XF-104s and the YF-104As. The YF-104As were longer, being 54.77 feet in length, which was to remain constant for all subsequent variants of the Starfighter, to include the two-seat versions. The nose gear strut was moved to the aft end of the gear well, and a small fairing was added along the entire length of the spine. As originally produced, the YF-104As did not have the ventral strake that was added later.

The intakes were redesigned, and a half-cone was added to each intake. This was considered secret at first, and the intakes were covered with tapered sheet metal covers known as "flight falsies." Early in-flight photographs of these aircraft had the cones touched out by censors.

The J79-GE-3A engine was installed in the YF-104s, and eventually the speed exceeded Mach 2. However, the engine proved troublesome, and several crashes resulted from engine flameouts, ignition failures, and other problems. It was 1958 before General Electric solved the problems and produced the J79-GE-3B which was retrofitted to existing aircraft.



The F-104A saw service with the Air Defense Command between 1958 and 1960. After being reassigned to Guard units, they were brought back to ADC service in the 1962/63 time frame because of the Berlin Crisis and Cuban missile crisis. They were assigned to the 319th FIS at Homestead AFB, Florida, and the 331st FIS at Webb AFB, Texas. These reactivated F-104s were retrofitted with the 20mm Vulcan cannon that had been missing from F-104As in their earlier service. In later service with ADC, the Starfighters were usually painted ADC gray with both the tops and the bottoms of their wings being white. The aft fuselage area around the engine was left bare metal. This F-104A was assigned to the 319th FIS, and was photographed in May 1964. (Sullivan collection)

By the time the F-104A was ready for production, the Tactical Air Command was no longer interested in the aircraft. They had already received the F-100 Super Sabre, and were in the process of adding the F-105 Thunderchief to their inventory. But with the developmental problems of the F-106, the Air Defense Command accepted a few F-104As into four of its fighter interceptor squadrons. The first to receive the Starfighter was the 83rd FIS at Hamilton AFB, California. The F-104A entered service with this unit on February 20, 1958, followed by the 337th FIS which activated at Westover AFB, Massachusetts, in April that same year. That June, the 538th FIS received the F-104A at Larson AFB, Washington, and the following month the 56th FIS transitioned from the F-86D/-L to the F-104A at Wright Patterson AFB, Ohio. All of these aircraft were initially in the natural metal scheme with white upper surfaces on the wings. They had no internal armament, since problems with the Vulcan cannon had delayed its installation. In September 1958, the 83rd FIS deployed with its F-104As to the Republic of China during the Quemoy crisis.

Several limitations of the Starfighter caused its initial service with ADC to be quite short. First, the F-104A and its Sidewinder missiles did not have an all-weather capability. It was lightly armed, because it had no cannon installed and therefore carried only two Sidewinder missiles. Its airframe was so small that it could not be fitted with equipment to tie it into the ground control equipment (semi-automatic ground environment or SAGE) that controlled ADC's interceptors. By June 30, 1959, the 56th FIS deactivated only eighteen months after receiving the F-104A. In January 1960, the 83rd FIS transitioned to the F-101B Voodoo, and the 337th FIS and 538th FIS both deactivated shortly thereafter.

As the four fighter interceptor squadrons gave up their F-104As, the aircraft were sent to three squadrons of the Air National Guard. Gaining units were the 157th FIS at McEntire ANGB, South Carolina, the 151st FIS at McGhee-Tyson ANGB, Tennessee, and the 197th FIS at Skyharbor Airport, Arizona. These three units received their F-104As between March and June 1960. During the Berlin crisis in October 1961, the 157th FIS deployed to Moron Air Base in Spain, and the 151st FIS and the 197th FIS deployed to Germany's Ramstein Air Base. They remained in Europe until early 1962, then returned to their home bases. In November and December 1962, during the Cuban missile crisis, the 157th FIS deployed to Florida.

After the Berlin crisis in 1961 and the Cuban missile crisis in 1962, the Air Defense Command decided that it could again use the F-104A. So early in 1963, the aircraft that were assigned to the three Air National Guard squadrons were transferred back to two ADC squadrons. These were the 319th FIS at Homestead AFB, Florida, and the 331st FIS at Webb AFB, Texas. These aircraft were retrofitted with the Vulcan cannon with 725 rounds of ammunition, and those assigned to the 319th FIS had the more powerful J79-GE-19 engine installed. The aircraft of both squadrons had their fuselage and tail sections, except for the area around the afterburner, painted ADC gray. Both the tops and bottoms of their wings were painted white.

In May 1965, the 331st FIS deployed to Puerto Rico during the crisis in the Dominican Republic, while the 319th stayed at Homestead to counter the threat posed by Soviet-built aircraft in Cuba. In December 1968, the 331st FIS transferred its F-104As to Davis Monthan AFB, Arizona, for storage, and the 319th FIS phased out of the F-104A a year later in December 1969. Shortly afterwards, a detachment of F-106 Delta Darts from the 48th FIS based at Langley AFB, Virginia, was assigned to Homestead AFB.

Pakistan was the first foreign nation to use the F-104, receiving twelve F-104A/-Bs in September 1961. Two more were sent to Pakistan in 1965. These aircraft were fitted with J79-GE-11A engines.

In July 1969, Jordan received eighteen F-104A/-Bs, also with the J79-GE-11A engines. Eight additional aircraft were sent at later dates in two batches of four aircraft each.

The Republic of China was the third country to receive F-104A/-Bs, taking delivery of twenty-two aircraft in September 1970. These aircraft had the J79-GE-19 engine installed, because they were the aircraft that had formerly been assigned to the 319th FIS and equipped with this version of the J79 engine.

Other F-104As were converted to drones beginning in early 1961. A total of twenty-four were converted to the QF-104A configuration. These aircraft continued in service until the middle of 1972, and were used at Eglin AFB, Florida.

F-104As were also used at Edwards AFB, California, for testing, and three were used by NASA for various research programs. Three were operated for a short time by the U.S. Navy. Three other aircraft were converted to NF-104s and used for the Aerospace Research Pilot Training Program at Edwards AFB. More information on the NF-104 can be found beginning on page 25.

Data for the F-104A was as follows:

Weights

Empty	12,782 pounds
Basic	12,939 pounds
Design	15, 200 pounds
Combat (with 2 X AIM-9B)	17,768 pounds
Maximum takeoff	24,808 pounds
Maximum landing	13,800 pounds

Electronics

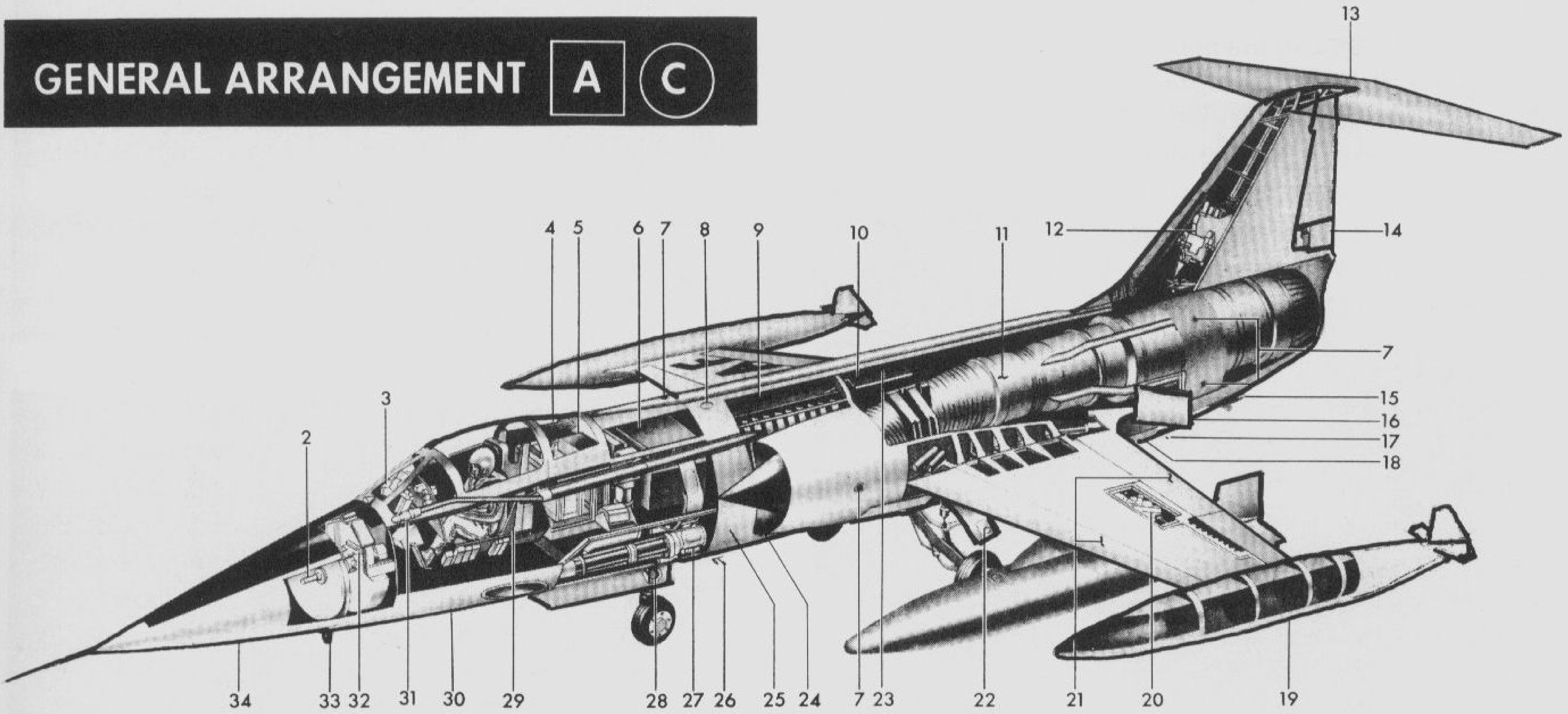
UHF Command	AN/ARC-66
Fire Control System	AN/ASG-14T-1
IFF	AN/APX-35
ILS	AN/ARN-57
VHF Navigation	AN/ARN-56
Tacan	AN/ARC-21

Production blocks for the F-104A were as follows:

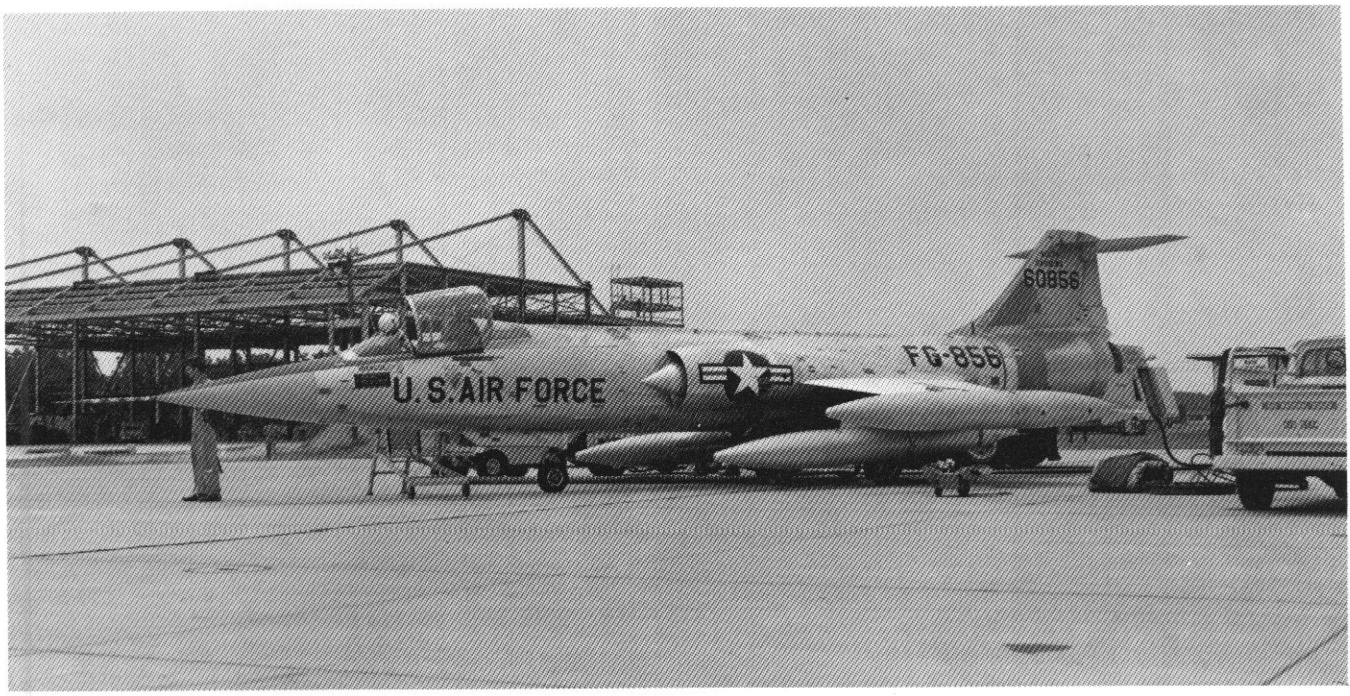
Block	Serial Numbers	Quantity
F-104A-1-LO	56-730 thru 56-736	7
F-104A-5-LO	56-737 thru 56-747	11
F-104A-10-LO	56-748 thru 56-763	16
F-104A-15-LO	56-764 thru 56-788	25
F-104A-20-LO	56-789 thru 56-825	37
F-104A-25-LO	56-826 thru 56-877	52
F-104A-30-LO	56-878 thru 56-882	5

Counting the seventeen YF-104As, which were added to the operational inventory, the total F-104As produced was 170.

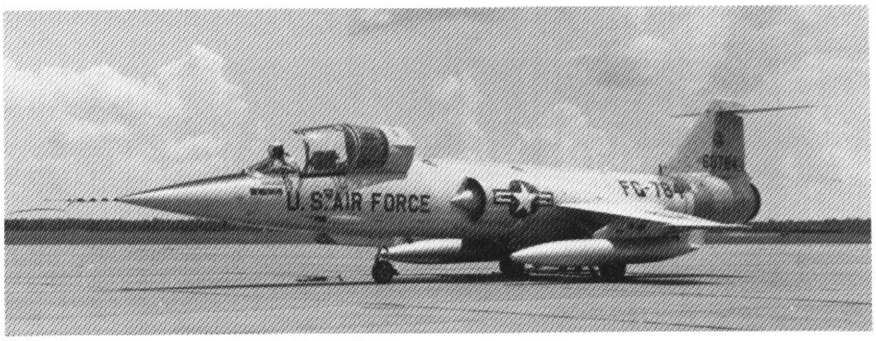
GENERAL ARRANGEMENT A Ⓒ



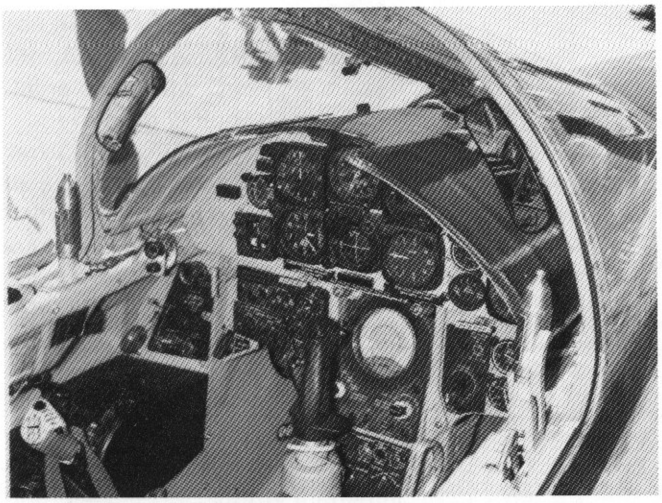
1 PITOT-STATIC BOOM
2 RADAR ANTENNA
3 OPTICAL GUNSIGHT, INFRARED GUNSIGHT AND CAMERA
4 VOR ANTENNA
5 ELECTRONICS COMPARTMENT
6 AMMUNITION COMPARTMENT
7 NAVIGATION LIGHTS
8 AUXILIARY FUEL CELL AND FILLER WELL
9 FORWARD MAIN FUEL CELL
10 AFT FUEL CELLS
11 J79 ENGINE AND AFTERBURNER
12 HORIZONTAL STABILIZER POWER CONTROL ASSEMBLY
13 CONTROLLABLE HORIZONTAL STABILIZER
14 YAW DAMPER
15 DRAG CHUTE DOOR
16 SPEED BRAKE
17 ARRESTING HOOK
18 VENTRAL FIN, (IFF AND TACAN ANTENNA, SOME A AIRPLANES)
19 TIP TANK
20 LEFT AILERON POWER CONTROL ASSEMBLY
21 LEADING EDGE AND TRAILING EDGE FLAPS
22 LANDING LIGHT
23 FILLER WELL (FORWARD MAIN AND AFT FUEL CELLS)
24 ENGINE AIR INTAKE DUCT
25 UHF ANTENNA A
26 LINK EJECTION CHUTE
27 20-MM GUN
28 TAXI LIGHT
29 EJECTION SEAT
30 UHF AND IFF ANTENNA Ⓒ
31 AIR REFUELING PROBE Ⓒ
32 RADAR
33 TACAN ANTENNA Ⓒ SOME A AIRPLANES
34 GLIDE SLOPE ANTENNA



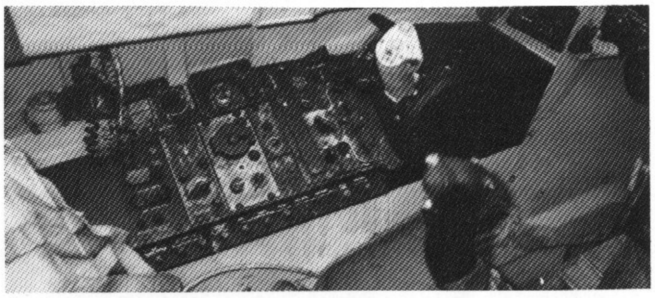
In addition to the external tip tanks, F-104As could also carry underwing fuel tanks as illustrated here. This aircraft belongs to the South Carolina Air National Guard's 157th FIS, and it was photographed in 1963 just prior to its reassignment to the USAF. It was the last F-104 in service with the South Carolina ANG. (Taylor collection)



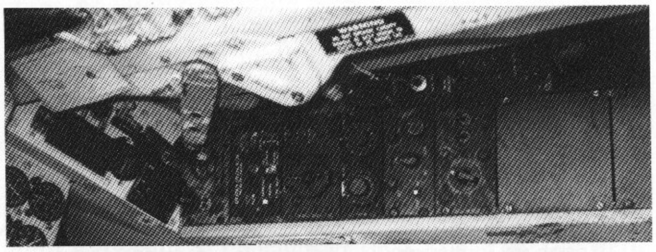
Back in service with the USAF and ADC, F-104A, 56-784, is shown here on August 15, 1965, in the markings of the 319th FIS. The photograph was taken at Homestead Air Force Base, Florida. Underwing fuel tanks are fitted, and are painted with a silver lacquer along with their pylons. Missile rails are attached to the wing tips. The aircraft has an ADC gray fuselage with white wings. (Mayer via Sullivan)



Details of the instrument panel in an F-104A are revealed in this photograph taken in 1966. Colors are the same as that shown for the F-104C on page 36. (Piedimonte via Sullivan)



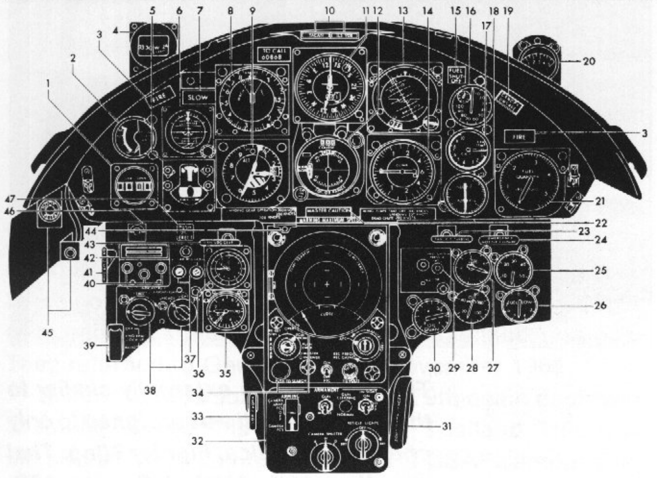
This is the left console in an F-104A.



Right console details are revealed in this photograph.

F-104A COCKPIT DETAILS

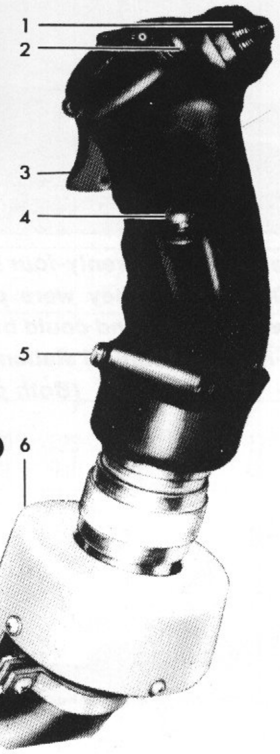
TYPICAL INSTRUMENT PANEL A FORWARD COCKPIT B



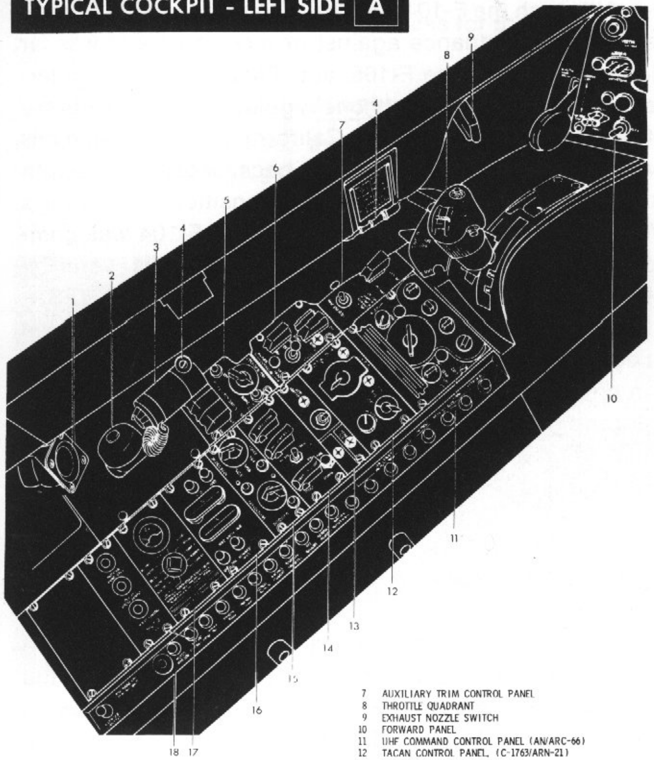
1 REMOTE CHANNEL FREQUENCY INDICATOR
2 COMPRESSOR INLET TEMPERATURE GAGE
3 FIRE WARNING LIGHTS (2)
4 STANDBY COMPASS
5 TURN-AND-SLIP INDICATOR
6 STANDBY ATTITUDE INDICATOR
7 COMPRESSOR INLET TEMPERATURE WARNING LIGHT
8 AIRSPEED AND MACH NUMBER INDICATOR
9 ALTIMETER
10 TACAN-ILS/VOR INDICATOR LIGHTS
11 BEARING DISTANCE HEADING INDICATOR (ID-526)
12 COURSE INDICATOR
13 ATTITUDE INDICATOR
14 VERTICAL VELOCITY INDICATOR
15 MAIN FUEL SHUTOFF VALVE WARNING LIGHT
16 TACHOMETER
17 EXHAUST GAS TEMPERATURE GAGE
18 EXHAUST NOZZLE POSITION INDICATOR
19 CANOPY UNSAFE (FLASHING) WARNING LIGHT
20 AUTOMATIC PITCH CONTROL INDICATOR
21 FUEL QUANTITY INDICATOR
22 MASTER CAUTION LIGHT AND RESET BAR
23 RAM AIR TURBINE EXTENSION HANDLE
■24 EMERGENCY NOZZLE CLOSURE HANDLE 19 11A 11B
25 CABIN ALTIMETER
26 FUEL FLOW INDICATOR
27 HYDRAULIC SYSTEMS PRESSURE GAGE
28 OIL PRESSURE GAGE
29 HYDRAULIC SYSTEMS PRESSURE GAGE SELECTOR SWITCH
30 NUCLEONIC OIL QUANTITY INDICATOR
31 CANOPY JETTISON HANDLE
32 ARMAMENT CONTROL PANEL A
33 RUDDER PEDAL ADJUSTMENT HANDLE
34 RADAR INDICATOR AND CONTROL PANEL
35 ACCELEROMETER
36 CLOCK
37 WING FLAP POSITION INDICATORS
38 GUNSIGHT CONTROL SWITCHES
39 INLET GUIDE VANES SWITCH 3B, RPM LOCKUP OVERRIDE SWITCH 19
40 LANDING GEAR POSITION INDICATOR LIGHTS
41 DRAG CHUTE HANDLE
42 STABILIZER AND AILERON TAKEOFF TRIM INDICATOR LIGHTS
43 MANUAL LANDING GEAR RELEASE HANDLE
44 FLAP ASYMMETRY WARNING LIGHT
45 ARRESTING HOOK RELEASE BUTTON AND ARRESTING HOOK DOWN WARNING LIGHT
46 RADAR LOCK-ON SENSITIVITY CONTROL
47 VGI PUSH-TO-ERECT

CONTROL STICK GRIP

1 AILERON AND HORIZONTAL STABILIZER TRIM SWITCH
2 EXTERNAL STORES RELEASE BUTTON (BOMB/ROCKET BUTTON)
3 CAMERA-ARMAMENT TRIGGER SWITCH (OPERATIVE IN FORWARD COCKPIT ONLY ON B D AIRCRAFT)
4 RADAR TRACK ACTION BUTTON
5 NOSE WHEEL STEERING BUTTON
6 STICK SHAKER

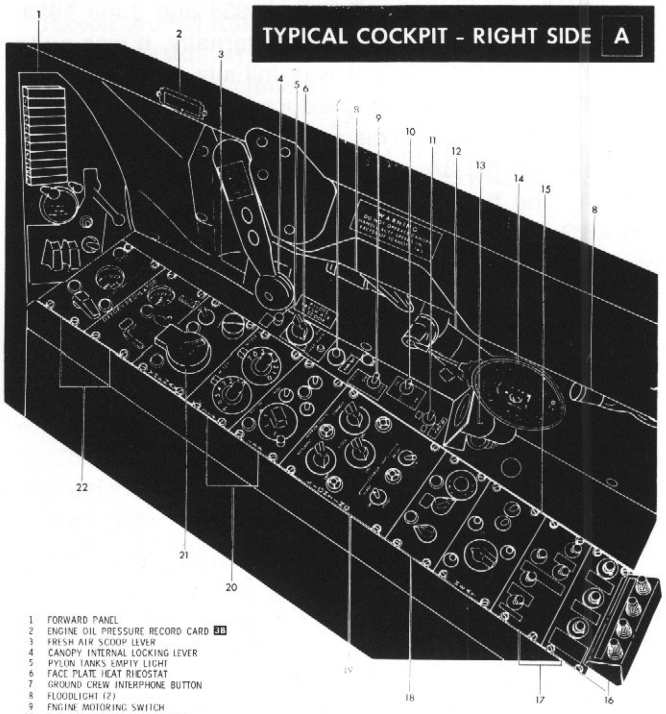


TYPICAL COCKPIT - LEFT SIDE A

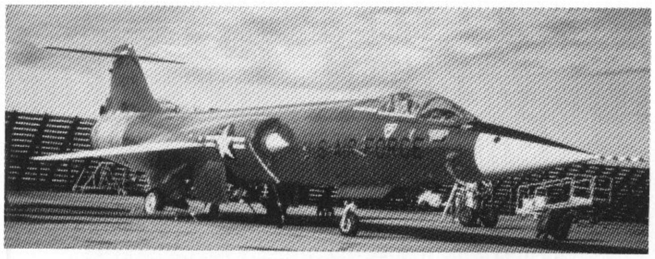


1 THUNDERSTORM LIGHT
2 ANTI-G SUIT VALVE
3 SPOTLIGHT
4 FLOODLIGHT (2)
5 TRIM AND STABILITY CONTROL PANEL
6 FUEL CONTROL PANEL
7 AUXILIARY TRIM CONTROL PANEL
8 THROTTLE QUADRANT
9 EXHAUST NOZZLE SWITCH
10 FORWARD PANEL
11 UHF COMMAND CONTROL PANEL (AN/ARC-66)
12 TACAN CONTROL PANEL, (C-1763/ARN-21)
13 ID-249 CDI SELECTOR SWITCH
14 AUTO-PITCH CUTOUT PANEL
15 MISSILE CONTROL PANEL
16 CIRCUIT BREAKER PANEL
17 RADAR AND ARMAMENT GROUND TEST PANEL
18 CIRCUIT BREAKER PANEL

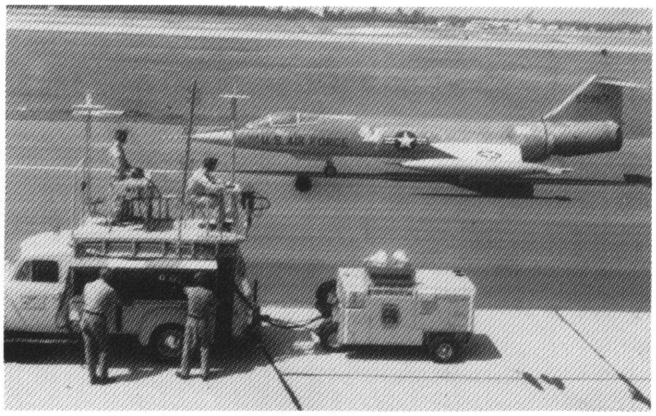
TYPICAL COCKPIT - RIGHT SIDE A

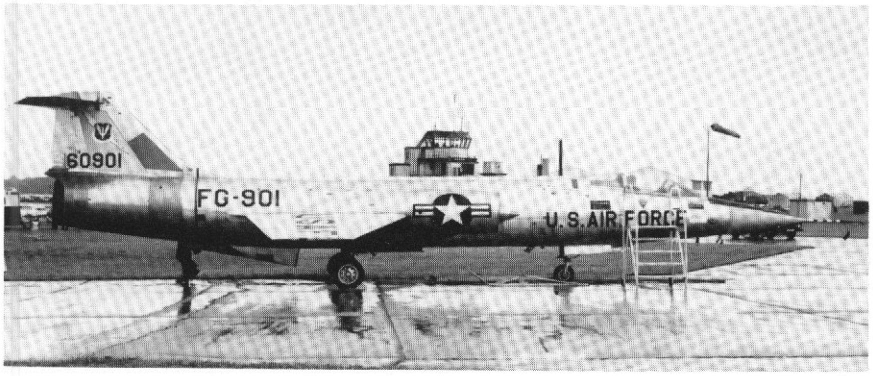


1 FORWARD PANEL
2 ENGINE OIL PRESSURE RECORD CARD 3B
3 FRESH AIR SCOOP LEVER
4 CANOPY INTERNAL LOCKING LEVER
5 PYLON TANKS EMPTY LIGHT
6 FACE PLATE HEAT RHEOSTAT
7 GROUND CREW INTERPHONE BUTTON
8 FLOODLIGHT (2)
9 ENGINE MOTORING SWITCH
10 THUNDERSTORM LIGHTS SWITCH
11 VENTILATED SUIT BLOWER SWITCH
12 SPOTLIGHT
13 THUNDERSTORM LIGHT
14 COMPUTER
15 HEATING CONTROL PANEL
16 FUSE PANEL
17 CIRCUIT BREAKER AND GROUND TEST PANELS
18 J-4 HEADING INDICATOR CONTROL PANEL
19 INTERIOR AND EXTERIOR LIGHTING CONTROL PANEL
20 IFF CONTROL PANELS
21 VHF NAVIGATION CONTROL PANEL
22 OXYGEN PANELS



Above and right: Twenty-four F-104As were converted to QF-104 drones. They were painted bright red-orange with white wings, and could be flown by a pilot or from a truck-mounted control station seen in the photograph at right. (Both photos, USAF via Menard)





The F-104C was externally similar to the F-104A, and it was assigned to only one USAF Tactical Fighter Wing. That was the 479th TFW at George AFB, California, which began conversion to the Starfighter from the F-100 Super Sabre in late 1958. This F-104C is shown in basic TAC markings on a bare metal scheme in 1962. The tops of the wings are white, and the radome is gray with a black anti-glare panel. No unit markings are carried. (MAP)

The second single-seat version of the Starfighter to serve with the U.S. Air Force was the F-104C. Its first flight took place in July 1958, and deliveries were made to the U.S. Air Force between October 1958 and June 1959. Only seventy-seven were built. Externally, it was quite similar to the F-104A, but was initially fitted with the J79-GE-7 engine which produced 15,800 pounds of thrust in afterburner. This was a 1,000 pound increase over the J79-GE-3A and -3B originally installed in the F-104A. The fire control system was improved to the AN/ASG-14T-2 over the -1 in the F-104A, and a detachable in-flight refueling probe was provided. When carried, this probe was attached to the left side of the forward fuselage from the intake to the area just under the canopy.

But the primary difference between the F-104A and F-104C was the latter's ability to carry and deliver air-to-ground ordnance of both the nuclear and conventional types. A centerline hardpoint was added to carry nuclear stores and other ordnance. From 1961 to 1963, Project Grindstone increased the number of Sidewinder missiles that could be carried from two to four with the addition of the capability to carry fuselage-mounted launch rails as well as those on the wing tips. Externally-carried stores that were certified for the F-104C included single Mk-28, Mk-43, MD-6, and BDU-8B stores on the centerline station. A SUU-21 practice dispenser could also be carried on the fuselage hardpoint. Two Mk-117, M129E1/2, BLU-1, or BLU-27 stores could be carried on the pylons under the wings as could 2.75-inch and 5-inch rocket pods. Internally, the F-104C carried the Vulcan 20mm cannon with 725 rounds of ammunition.

The F-104C had an empty weight of 12,760 pounds, a combat weight of 19,470 pounds, and a maximum takeoff weight of 22,410 pounds.

Although the F-104C did have some capability to carry and deliver ordnance against ground targets, it was far less than that of the F-105, and TAC still was not interested in the aircraft. Only one regular Air Force wing, the 479th TFW at George AFB, California, ever operated this version of the Starfighter. It first became operational with this unit in September 1958, and transition of the wing's four squadrons from the F-100 to the F-104 was completed the following year. These squadrons were the 434th TFS, 435th TFS, 436th TFS, and the 479th TFS.

Beginning in November 1979, the 479th TFW assumed a commitment to maintain one of its squadrons in Europe on a rotational basis. The aircraft were usually based at Moron Air Base, Spain, for this commitment, but deployed temporarily to Bittburg AFB, Germany, during the Berlin crisis in October 1961. At the same time, two other squadrons from the 479th also deployed to Europe. One flew to Hahn AB, and the other went to Ramstein AB, Germany. The deployment of these two squadrons was made on only a few hours notice, and one of the squadrons flew non-stop from George AFB to Spain. One of the squadrons returned to Moron AB in June of 1962, and the other two returned to George AFB, California. The European commitment ended in early 1963.

When the Cuban crisis erupted in October, November, and December of 1962, the squadron in Moron deployed to Hahn AB, Germany, and all three of the squadrons based at George AFB moved to Key West, Florida. Once the crisis was over, they returned to their usual home base, and then took part in the classified operation, Project "Diamond Lil" in November 1963. This involved a deployment to the Arctic Region. A second deployment to the Arctic Region was made in 1965 when the unit participated in Project "Polar Strike."

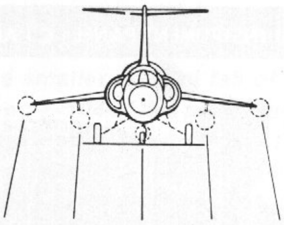
In April 1965, a squadron from George AFB deployed to Da Nang AB, Vietnam, to provide air defense for South Vietnam. During this deployment, three squadrons of the 479th flew 2,269 combat missions totaling 8,820 hours. Since no air-to-air engagements took place, the squadron turned its attention to flying ground attack missions. They returned to George AFB in November 1965.

In June 1966, a squadron of the 479th again deployed to southeast Asia, this time to Udorn, Thailand. This time the aircraft were painted in standard USAF camouflage, and flew more ground support missions. During this second deployment to SEA, the 435th TFS flew a total of 506 sorties and 1,706.9 flight hours. But the F-104C's limited ability to perform in the fighter-bomber role caused it to be withdrawn from combat for the final time in July 1967. It was at this time that the Tactical Air Command phased the F-104C out of service. Some of the aircraft were then assigned to the 198th TFS of the Puerto Rican Air National Guard. This unit became the last U.S. unit to operate any version of the F-104, initially receiving sixteen F-104Cs, six F-104Ds, and two F-104Bs. Other F-104Cs were used for testing at Edwards AFB, but these too were soon retired.

There were only two production blocks for the F-104C as follows:

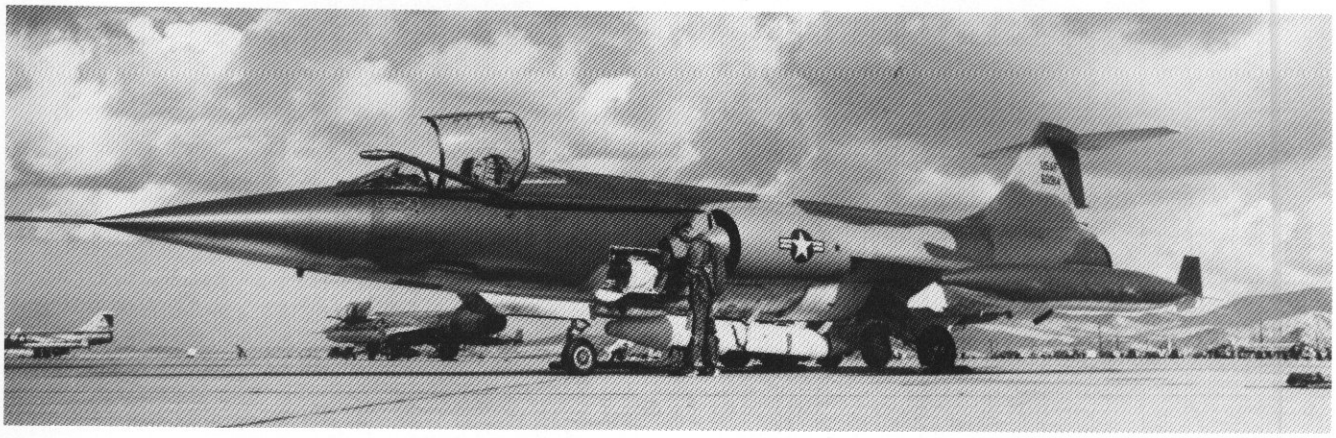
Block	Serial Numbers	Quantity
F-104C-5-LO	56-883 thru 56-938	56
F-104C-10-LO	57-910 thru 57-930	21
Total		77

EXTERNAL STORES CAPABILITY



	STA. 1	STA. 2	STA. 3	STA. 4	STA. 5
SPECIAL WEAPONS					
Variety of bombs	—	—	■	—	—
MISSILES					
Air-to-surface missile	—	■	—	■	—
Sidewinder air-to-air missile	■	—	■■	—	■
FUEL TANKS					
Fuselage pylon wing tip	170 Gal.	195 Gal.	225 Gal.	195 Gal.	170 Gal.
CONVENTIONAL WEAPONS					
Large general purpose bomb	—	—	■	—	—
Either 1000 lb., 500 lb., or 250 lb. G.P. bomb	—	■	■	■	—
750 lb. demolition bomb	—	■	■	■	—
Either 750 lb. or 500 lb. fire bomb	—	■	■	■	—
ROCKETS					
19 2.75-inch rockets in pod	—	■	—	■	—
5 5-inch rockets in pod	—	■	—	■	—

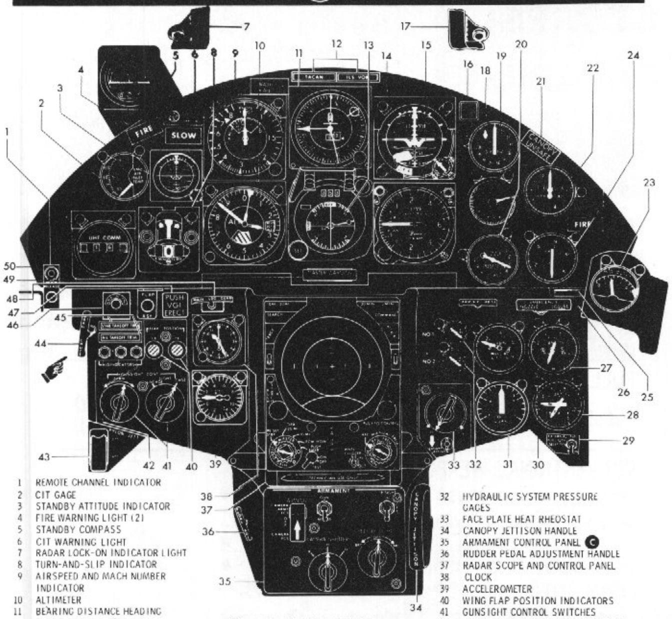
Maximum speed . . . . Mach 2.2 to 2.3 at altitudes from 35,000 feet to 55,000 feet.
Touchdown velocity . . . . 135-140 knots
Approach velocity . . . . 200 knots
Takeoff ground roll with normal takeoff weight (std. day, std. temp.) . . . . 2200 feet
Maximum rate of climb at ground level . . . . 5600 f.p.m.
Time to climb to 36,000 feet. . . . . 1.6 min.
Range without external tanks. . . . 800 nautical miles
Range with four external tanks (ferry flight) . . . . 1900 nautical miles



F-104Cs could be fitted with a detachable in-flight refueling probe as illustrated here. A centerline hardpoint was a feature added to the F-104C that had not been present on the F-104A. In this photograph a dispenser of practice bombs is attached to this centerline hardpoint, and it has minimal clearance with the ground. Late in their service with the 479th TFW, the F-104C was painted in the standard camouflage paint scheme that is usually associated with Southeast Asia. (USAF via Haynes)

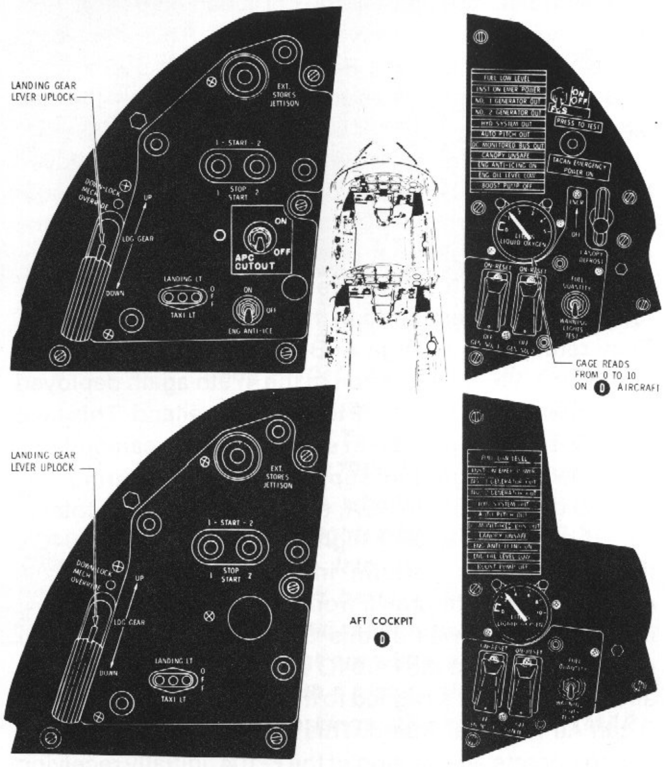
F-104C COCKPIT DETAILS

TYPICAL INSTRUMENT PANEL Ⓒ AND FORWARD COCKPIT Ⓓ

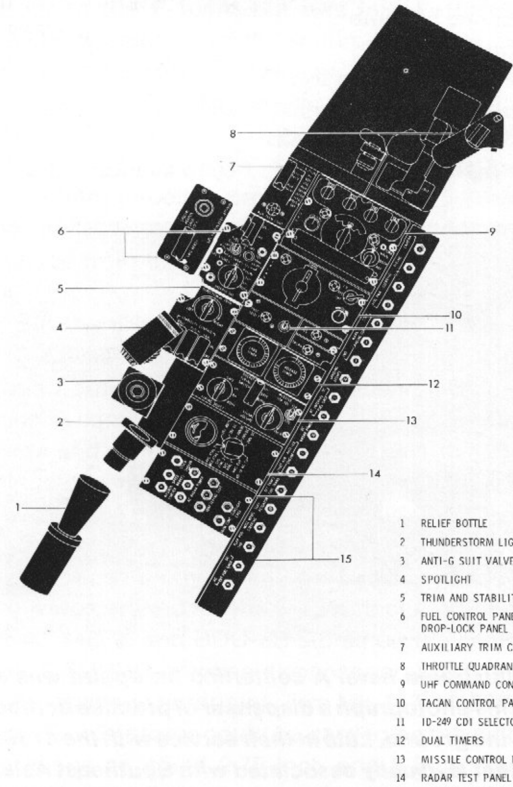


1 REMOTE CHANNEL INDICATOR
2 CIT GAGE
3 STANDBY ATTITUDE INDICATOR
4 FIRE WARNING LIGHT (2)
5 STANDBY COMPASS
6 CIT WARNING LIGHT
7 RADAR LOCK-ON INDICATOR LIGHT
8 TURN-AND-SLIP INDICATOR
9 AIRSPEED AND MACH NUMBER INDICATOR
10 ALTIMETER
11 BEARING DISTANCE HEADING INDICATOR (ID-526 BDHI)
12 TACAN-ILS/VOR INDICATOR LIGHTS
13 COURSE INDICATOR (ID-249)
14 ATTITUDE INDICATOR
15 VERTICLE VELOCITY INDICATOR
16 MAIN FUEL SHUT-OFF VALVE WARNING LIGHT
17 LADD INDICATOR LIGHT Ⓒ
18 TACHOMETER
19 EXHAUST GAS TEMPERATURE GAGE
20 EXHAUST NOZZLE POSITION INDICATOR
21 CANOPY UNSAFE (FLASHING) WARNING LIGHT
22 FUEL FLOW INDICATOR
23 AUTOMATIC PITCH CONTROL INDICATOR
24 OIL PRESSURE GAGE
25 RAM AIR TURBINE EXTENSION HANDLE
26 EMERGENCY NOZZLE CLOSURE HANDLE
27 INTERNAL FUEL QUANTITY INDICATOR
28 EXTERNAL FUEL QUANTITY INDICATOR
29 EXTERNAL FUEL QUANTITY SELECTOR SWITCH
30 CABIN ALTIMETER
31 NUCLEONIC OIL QUANTITY INDICATOR
32 HYDRAULIC SYSTEM PRESSURE GAGES
33 FACE PLATE HEAT RHEOSTAT
34 CANOPY JETTISON HANDLE
35 ARMAMENT CONTROL PANEL Ⓒ
36 RUDDER PEDAL ADJUSTMENT HANDLE
37 RADAR SCOPE AND CONTROL PANEL
38 CLOCK
39 ACCELEROMETER
40 WING FLAP POSITION INDICATORS
41 GUNSIGHT CONTROL SWITCHES
42 LANDING GEAR POSITION INDICATOR LIGHTS
43 PYLON JETTISON SWITCH
44 DRAG CHUTE HANDLE
45 STABILIZER AND AILERON TAKEOFF TRIM INDICATOR LIGHTS
46 RADAR LOCK-ON SENSITIVITY CONTROL
47 PUSH-TO-ERECT VERTICAL GYRO INDICATOR
48 MANUAL LANDING GEAR RELEASE HANDLE
49 MASTER CAUTION LIGHT AND RESET BAR
50 ARRESTING HOOK RELEASE BUTTON AND ARRESTING HOOK DOWN WARNING LIGHT

TYPICAL LEFT AND RIGHT FORWARD PANELS Ⓒ Ⓓ

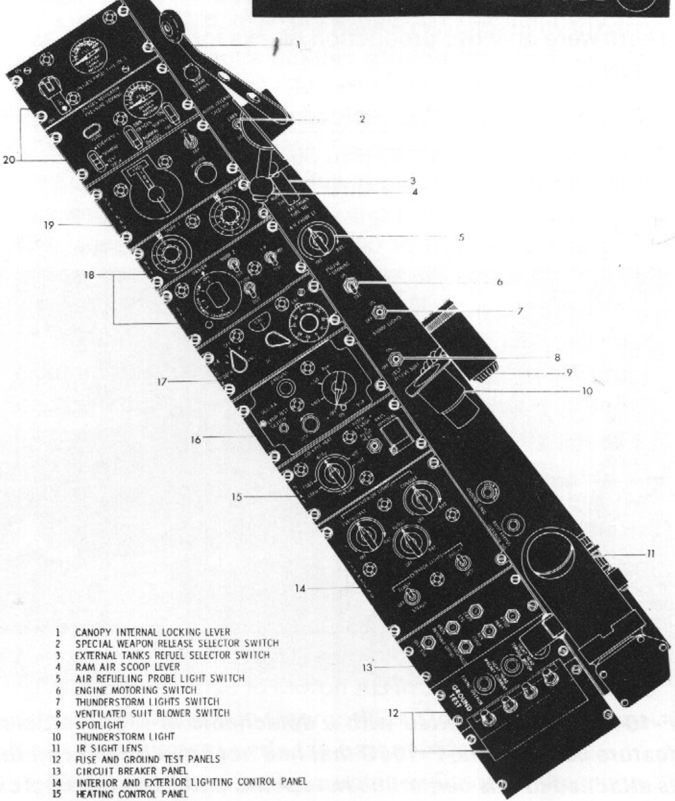


TYPICAL COCKPIT - LEFT SIDE Ⓒ



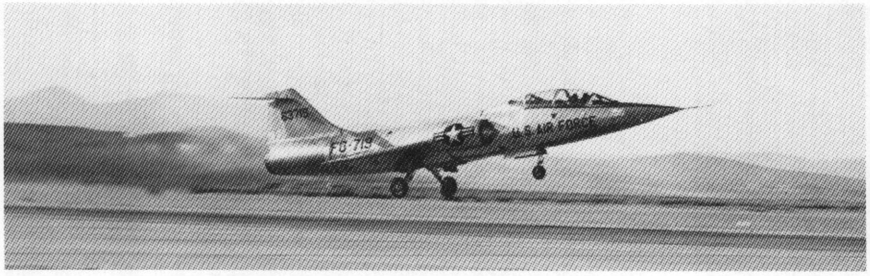
1 RELIEF BOTTLE
2 THUNDERSTORM LIGHT
3 ANTI-G SUIT VALVE
4 SPOTLIGHT
5 TRIM AND STABILITY CONTROL PANEL
6 FUEL CONTROL PANEL AND SPECIAL WEAPON DROP-LOCK PANEL
7 AUXILIARY TRIM CONTROL PANEL
8 THROTTLE QUADRANT
9 UHF COMMAND CONTROL PANEL (AN/ARC-66)
10 TACAN CONTROL PANEL (C1763/ARN-21)
11 ID-249 CDI SELECTOR SWITCH
12 DUAL TIMERS
13 MISSILE CONTROL PANEL
14 RADAR TEST PANEL
15 CIRCUIT BREAKER PANELS

TYPICAL COCKPIT - RIGHT SIDE Ⓒ



1 CANOPY INTERNAL LOCKING LEVER
2 SPECIAL WEAPON RELEASE SELECTOR SWITCH
3 EXTERNAL TANKS REFUEL SELECTOR SWITCH
4 RAM AIR SCOOP LEVER
5 AIR REFUELING PROBE LIGHT SWITCH
6 ENGINE MOTORING SWITCH
7 THUNDERSTORM LIGHTS SWITCH
8 VENTILATED SUIT BLOWER SWITCH
9 SPOTLIGHT
10 THUNDERSTORM LIGHT
11 IR SIGHT LENS
12 FUSE AND GROUND TEST PANELS
13 CIRCUIT BREAKER PANEL
14 INTERIOR AND EXTERIOR LIGHTING CONTROL PANEL
15 HEATING CONTROL PANEL
16 DCU-9/A PANEL
17 J-4 HEADING INDICATOR PANEL
18 IFF/SIF CONTROL-PANELS
19 VHF NAVIGATION CONTROL PANEL (AN/ARN-56)
20 OXYGEN CONTROL PANELS

F-104B & F-104D



The prototype for the F-104B is shown here taking off on its maiden flight. It had the smaller vertical tail of the F-104A and F-104C, but production aircraft were fitted with the larger tail and rudder. Note also the early two-seat canopy that was fitted to most -Bs and initially to some F-104Ds.

(Lockheed via Hayes)

Realizing the Starfighter would be a difficult aircraft to master, the Air Force ordered a two-place trainer version of the F-104A. With the same electronics and other equipment, the F-104B lacked only the Vulcan cannon and gunsight retrofitted to the F-104A in 1964. A portion of the internal fuel capacity was also deleted to make room for the second cockpit. With a thirsty engine and relatively little internal fuel to start with, F-104Bs were seldom seen without their external tanks on the wing tips. The size of the vertical tail was increased for added lateral stability on all but the first F-104B. Two Sidewinder missiles could also be carried in place of the tip tanks, but these missiles were the only armament ever certified for the F-104B. Although the aircraft had this minimal capability to carry armament, the F-104B designator was used instead of TF-104 that Lockheed had first intended. In practice, the aircraft was used exclusively in the training and support missions, and not to stand alert next to its F-104A cousins.

The F-104B made its first flight on January 16, 1957. Six were ordered in 1956, and 106 more were ordered the following year. But like the F-104A production program, the production of F-104Bs was cut drastically, and only twenty-six of 112 were ever built. These aircraft were assigned to the same units that flew the F-104A, as well as to test and evaluation units. They also went to the ANG and foreign nations that received the F-104A, and some remained in service with the Puerto Rican ANG which also flew the F-104C and F-104D variants.

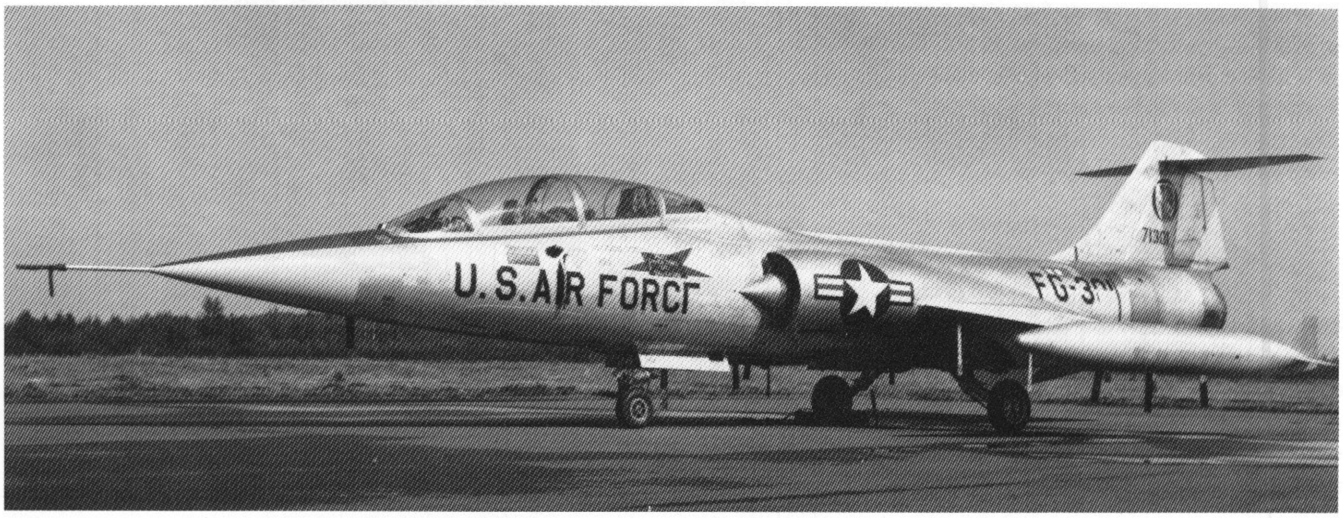
Production blocks for the F-104B were as follows:

Block	Serial Numbers	Quantity
F-104B*	56-3719	1
F-104B-1-LO	56-3720 thru 56-2724	5
F-104B-5-LO	57-1294 thru 57-1302	9
F-104B-10-LO	57-1303 thru 57-1311	9
F-104B-15-LO	57-1312 thru 57-1313	2
Total		26

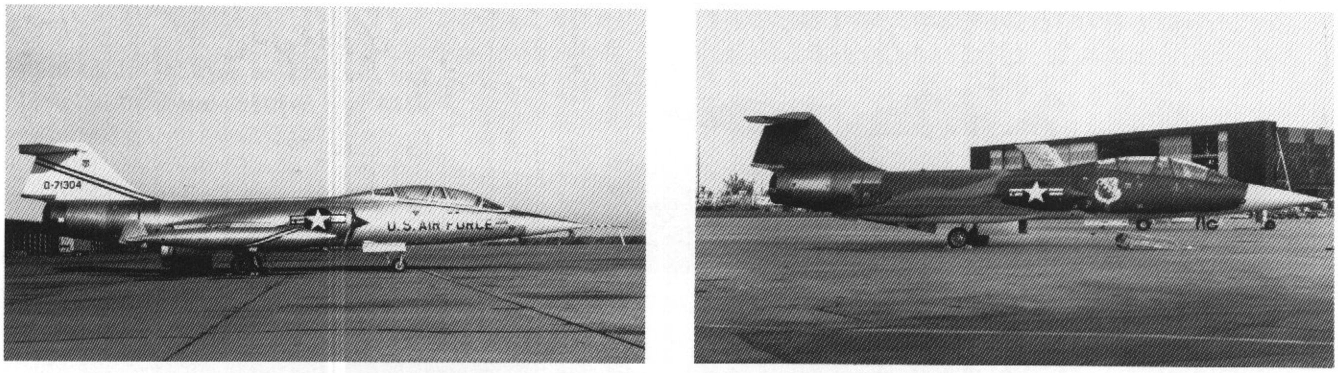
* The original F-104B was not assigned a block number.

The second two-seat trainer used by the USAF was the F-104D. Like the F-104B, it had the larger vertical tail, no cannon armament, but could be armed with Sidewinders and 2.75-inch rockets. Like the F-104C, it had provisions for in-flight refueling using the same detachable refueling probe.

Only twenty-one F-104Ds were built for the USAF, and most of these served alongside the F-104Cs in the 479th TFW. Others were used for testing and evaluation, and some went to the Puerto Rican ANG when that unit received the F-104C and -B aircraft. The F-104F was



This F-104B has the earlier style two-seat canopy with the single piece of metal framing between the two opening portions of the canopy. The fact that the nose gear on two-seat F-104s was at the forward end of the well is clearly illustrated here. Also note the lack of a gun fairing on this aircraft. The Vulcan cannon was deleted from the two-seat aircraft to make room for the aft cockpit. ***(Sullivan collection)***



At left, F-104B-10-LO, 57-1304, is shown in a bare metal scheme with a white vertical tail. The stripes on the tail and fuel tank are red, white, and blue. At right is 57-1305, which was the next F-104B that came off the production line. It is painted in standard camouflage scheme, and was photographed at Homestead AFB, Florida. The wing badge for the 31st TFW is applied to the fuselage forward of the intake, however, the 31st did not operate the Starfighter. When this photograph was taken on November 6, 1971, the 31st TFW was equipped with F-4E Phantoms. Note that this F-104B, and the one shown in the photograph at left, both have the later style two-seat canopy. This provides evidence that F-104Bs did not only have the earlier style canopy seen in the photographs on the previous page. Color photographs of the aircraft at right appear on page 34. ***(Left Flightleader collection, right Brady via Sullivan)***

basically an F-104D built for West German pilot training n Germany. Thirty F-104Fs were built in one production block, and were assigned serial numbers 59-4994 thru 59-5023. The two-seat versions had a nose gear that retracted rearward from the front end of the nose gear well.

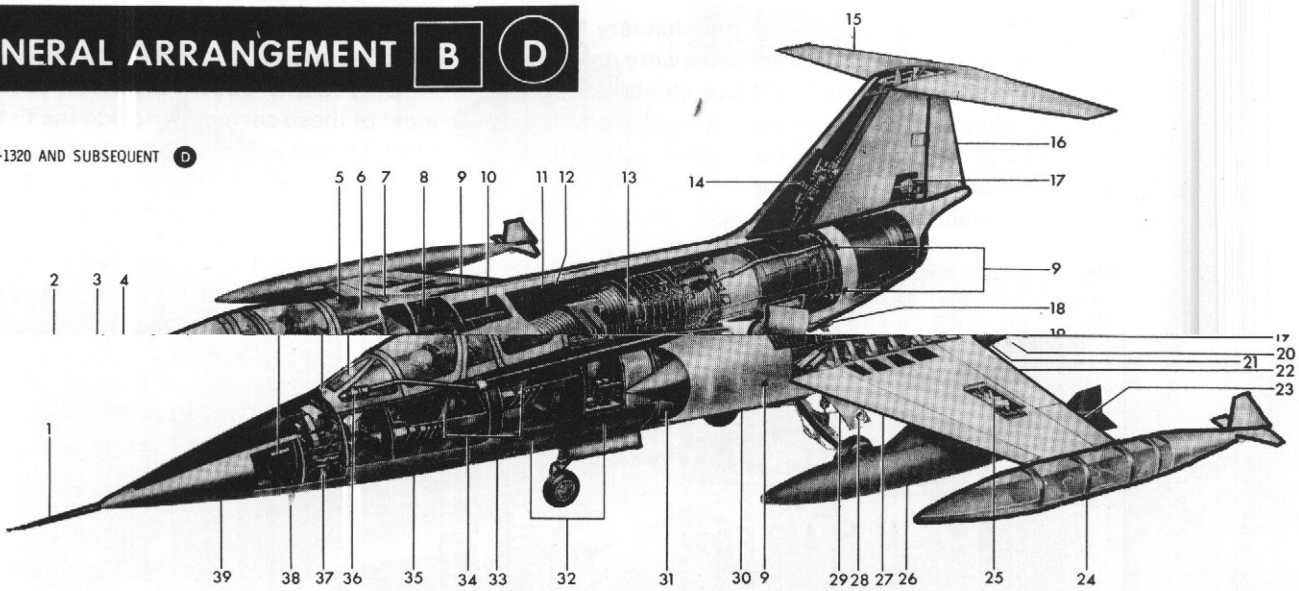
Production blocks for the F-104D were as follows:

Block	Serial Numbers	Quantity
F-104D-5-LO	57-1314 thru 57-1320	7
F-104D-10-LO	57-1321 thru 57-1328	8
F-104D-15-LO	57-1329 thru 57-1334	6
Total		21

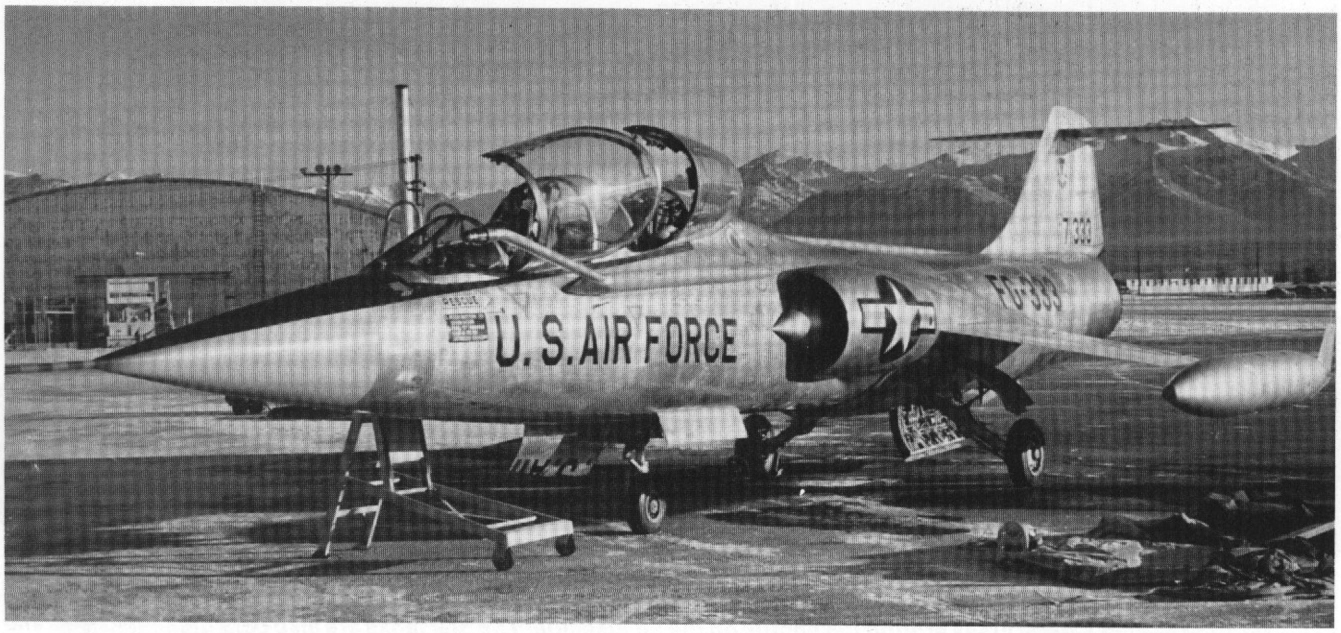
TYPICAL GENERAL ARRANGEMENT B Ⓓ

NOTE

△1 AF SERIALS 57-1320 AND SUBSEQUENT Ⓓ

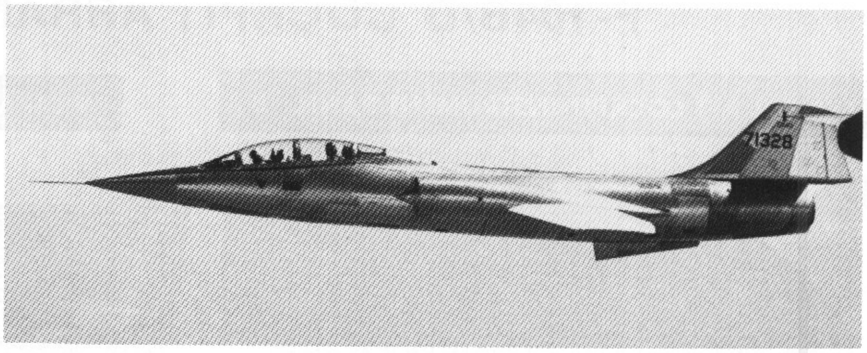


1 PITOT-STATIC BOOM
2 RADAR ANTENNA
3 INFRARED SIGHT WINDOW
4 OPTICAL SIGHT, INFRARED SIGHT AND CAMERA
5 VOR ANTENNA
6 ELECTRONICS COMPARTMENT
7 AUXILIARY FUEL CELL AND FILLER WELL △1
8 AIR CONDITIONING COMPARTMENT
9 NAVIGATION LIGHTS
10 FORWARD MAIN FUEL CELL
11 AFT FUEL CELLS
12 INTERNAL FUEL CELLS FILLER WELL
13 J79 ENGINE AND AFTERBURNER
14 HORIZONTAL STABILIZER POWER CONTROL ASSEMBLY
15 CONTROLLABLE HORITONTAL STABILIZER
16 RUDDER
17 RUDDER POWER CONTROL ASSEMBLY
18 DRAG CHUTE DOOR
19 SPEED BRAKE
20 ARRESTING HOOK
21 VENTRAL FIN, (IFF AND TACAN, SOME B AIRPLANES) (MARKER BEACON Ⓓ)
22 TRAILING EDGE FLAP
23 AILERON
24 TIP TANK
25 LEFT AILERON POWER CONTROL ASSEMBLY
26 PYLON TANK
27 LEADING EDGE FLAP
28 LANDING LIGHT
29 LANDING GEAR AFT DOOR
30 LANDING GEAR FORWARD DOOR
31 ENGINE AIR INTAKE DUCT △1
32 AUXILIARY FUEL CELLS △1
33 UHF ANTENNA
34 EJECTION SEATS
35 IFF ANTENNA
36 AIR REFUELING PROBE △1
37 RADAR
38 TACAN ANTENNA Ⓓ; SOME B AIRPLANES
39 GLIDE SLOPE ANTENNA



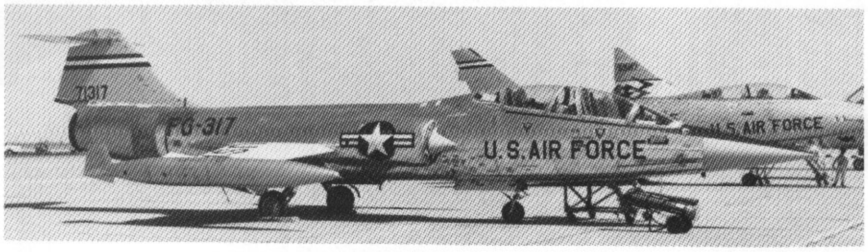
Just as the F-104B was the two-seat version of the F-104A, the F-104D was the two-seat version of the F-104C. It had the improvements made to the F-104C to include the detachable in-flight refueling probe and centerline hardpoint. The refueling probe can be seen on this aircraft, F-104D, 57-1333, which was the next to last F-104D built.

(Taylor via Hayes)

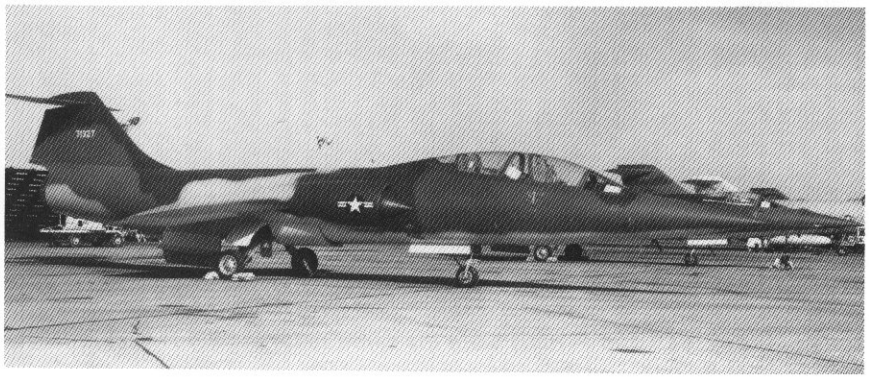


F-104D-10-LO, 57-1328, is seen here on its builder's acceptance flight. Note that this aircraft, the last F-104D-10-LO built, has the earlier style two-seat canopy with the single metal frame in the middle. This provides evidence that some F-104Ds were fitted with this earlier style canopy. Some publications have reported that this style canopy was only used on the F-104B.

(Lockheed via Haynes)

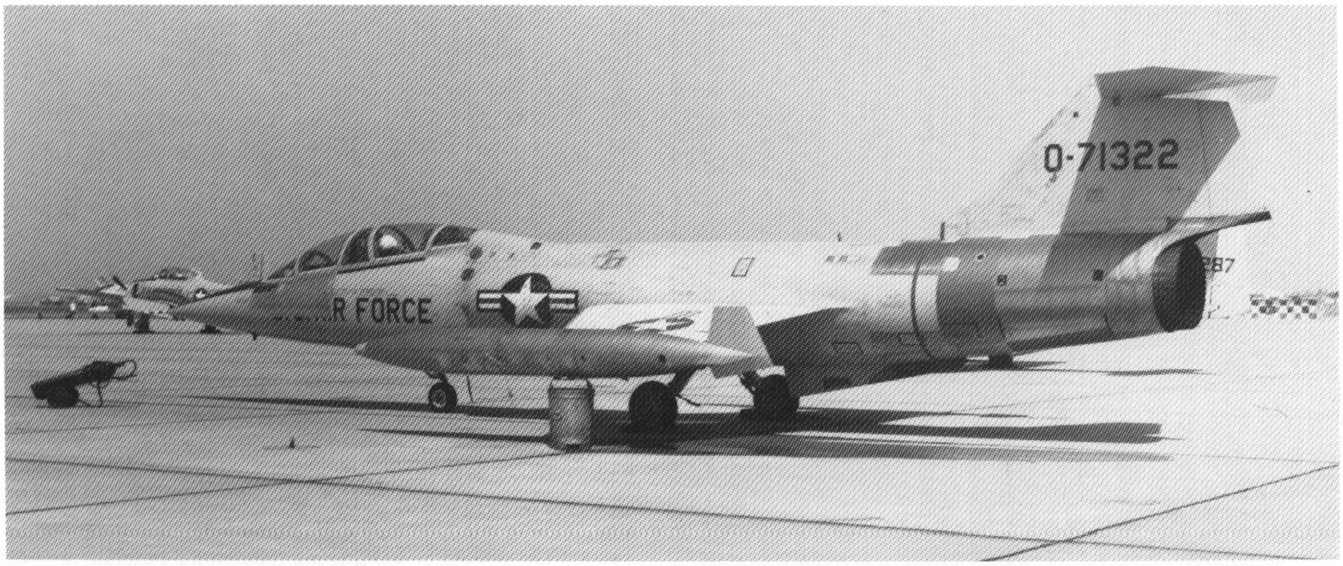


F-104D-10-LO, 57-1317, is illustrated in the bare metal scheme with the tops of the wings being painted white. The radome and vertical tail are ADC gray, and the stripes on the tail are red, white, and blue from top to bottom. The anti-glare panel is black on this aircraft. ***(MAP)***



F-104D-10-LO, 57-1327, must have been recently painted in the standard camouflage scheme when this photograph was taken. It was unusual to see any two-seat variant of the Starfighter without external tanks, because the internal fuel capacity was less than that of the single-seat versions. This was because the amount of internal fuel had to be decreased in order to install the second cockpit.

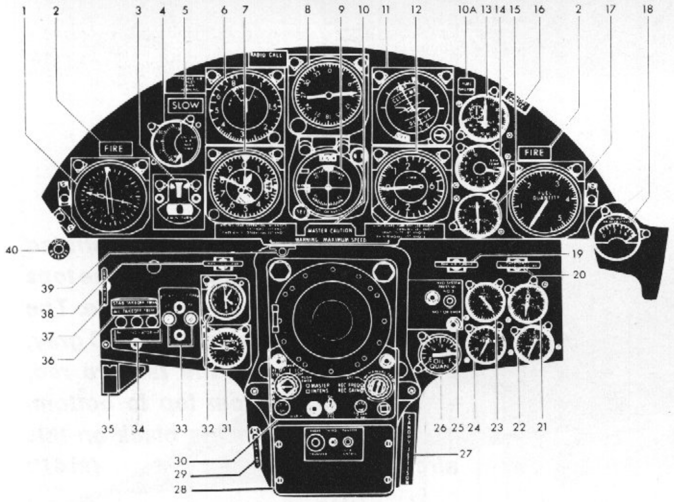
(Flightleader collection)



Standard markings have been applied to F-104D-10-LO, 57-1322, which has been painted in the ADC gray and white scheme. Note the bare metal areas around the engine on the aft fuselage. The fuel tanks are also bare metal. The size and location of the serial number on the tail is as specified in the Air Force tech order for painting non-camouflaged F-104s. However, many variations of both size and position of serial numbers could be found on Air Force Starfighters. (Flightleader)

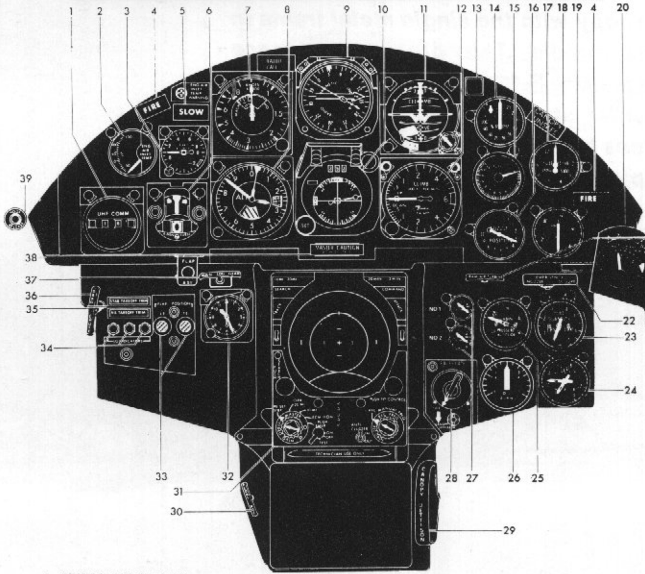
F-104B/D COCKPIT ARRANGEMENT

TYPICAL AFT COCKPIT-INSTRUMENT PANEL B



1 RADIO MAGNETIC INDICATOR
2 FIRE WARNING LIGHT (2)
3 TURN-AND-SLIP INDICATOR
4 COMPRESSOR INLET TEMPERATURE GAGE
5 COMPRESSOR INLET TEMPERATURE WARNING LIGHT
6 AIRSPEED AND MACH NUMBER INDICATOR
7 ALTIMETER
8 HEADING INDICATOR
9 COURSE INDICATOR
10 MASTER CAUTION LIGHT AND RESET BAR
10A MAIN FUEL SHUTOFF VALVE WARNING LIGHT
11 ATTITUDE INDICATOR
12 VERTICAL VELOCITY INDICATOR
13 TACHOMETER
14 EXHAUST GAS TEMPERATURE GAGE
15 EXHAUST NOZZLE POSITION INDICATOR
16 CANOPY UNSAFE (FLASHING) WARNING LIGHT
17 FUEL QUANTITY INDICATOR
18 AUTOMATIC PITCH CONTROL INDICATOR
19 RAM AIR TURBINE EXTENSION HANDLE
■ 20 EMERGENCY NOZZLE CLOSURE HANDLE 19 11A 11B
21 CABIN ALTIMETER
22 FUEL FLOW INDICATOR
23 HYDRAULIC SYSTEMS PRESSURE INDICATOR
24 OIL PRESSURE GAGE
25 HYDRAULIC SYSTEMS PRESSURE SELECTOR SWITCH
26 NUCLEONIC OIL QUANTITY INDICATOR
27 CANOPY JETTISON HANDLE
28 RADAR CONTROL TRANSFER PANEL
29 RUDDER PEDAL ADJUSTMENT HANDLE
30 RADAR INDICATOR AND CONTROL PANEL
31 ACCELEROMETER
32 CLOCK
33 WING FLAP POSITION INDICATORS
34 LANDING GEAR POSITION INDICATOR LIGHTS
35 INLET GUIDE VANES SWITCH 3B. RPM LOCKUP OVERRIDE SWITCH 19
36 STABILIZER AND AILERON TAKEOFF TRIM INDICATOR LIGHTS
37 DRAG CHUTE HANDLE
38 MANUAL LANDING GEAR RELEASE HANDLE
39 FLAP ASYMMETRY WARNING LIGHT
40 ARRESTING HOOK RELEASE BUTTON

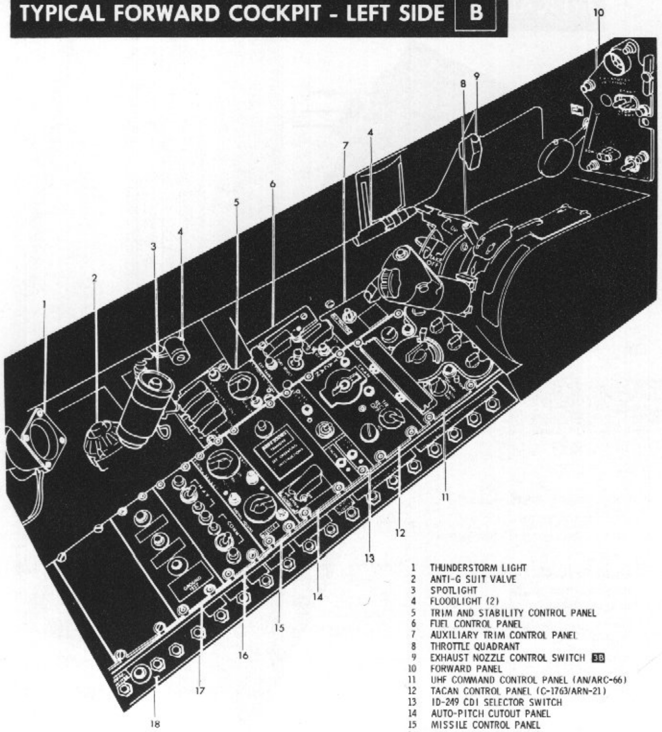
TYPICAL AFT COCKPIT INSTRUMENT PANEL D



1 REMOTE CHANNEL INDICATOR
2 COMPRESSOR INLET TEMPERATURE GAGE
3 ACCELEROMETER
4 FIRE WARNING LIGHT (2)
5 COMPRESSOR INLET TEMPERATURE WARNING LIGHT
6 TURN-AND-SLIP INDICATOR
7 AIRSPEED AND MACH NUMBER INDICATOR
8 ALTIMETER
9 RADIO MAGNETIC INDICATOR (ID-250)
10 COURSE INDICATOR (ID-249)
11 ATTITUDE INDICATOR
12 VERTICAL VELOCITY INDICATOR
13 MAIN FUEL SHUT-OFF VALVE WARNING LIGHT
14 TACHOMETER
15 EXHAUST GAS TEMPERATURE GAGE
16 EXHAUST NOZZLE POSITION INDICATOR
17 FUEL FLOW INDICATOR
18 CANOPY UNSAFE (FLASHING) WARNING LIGHT
19 OIL PRESSURE GAGE
20 AUTOMATIC PITCH CONTROL INDICATOR
21 RAM AIR TURBINE EXTENSION HANDLE
22 EMERGENCY NOZZLE CLOSURE HANDLE
23 INTERNAL FUEL QUANTITY INDICATOR
24 EXTERNAL FUEL QUANTITY INDICATOR
25 CABIN ALTIMETER
26 NUCLEONIC OIL QUANTITY INDICATOR
27 HYDRAULIC SYSTEM PRESSURE GAGES
28 FACE PLATE HEAT RHEOSTAT
29 CANOPY JETTISON HANDLE
30 RUDDER PEDAL ADJUSTMENT HANDLE
31 RADAR SCOPE AND CONTROL PANEL
32 CLOCK
33 WING FLAP POSITION INDICATORS
34 LANDING GEAR POSITION INDICATOR LIGHTS
35 STABILIZER AND AILERON TAKEOFF TRIM INDICATOR
36 DRAG CHUTE HANDLE
37 MANUAL LANDING GEAR RELEASE HANDLE
38 MASTER CAUTION LIGHT AND RESET BAR
39 ARRESTING HOOK RELEASE BUTTON

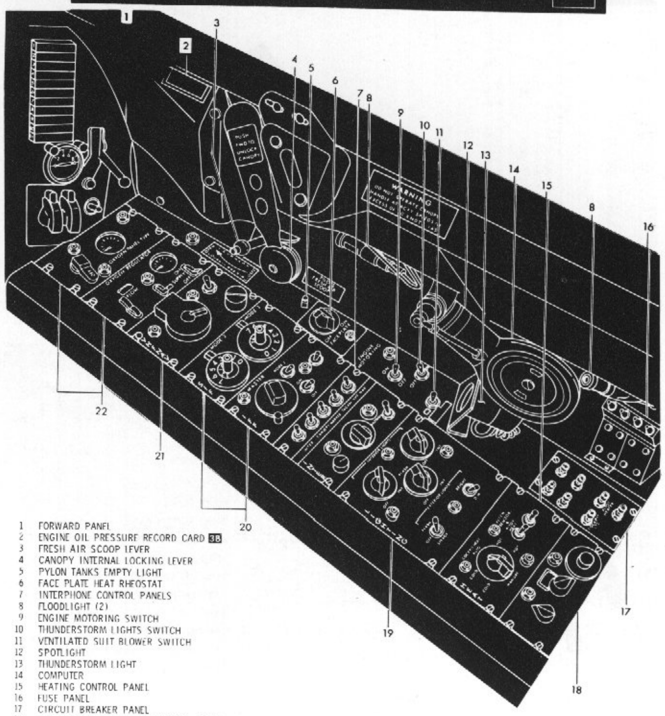
The instrument panels in the forward cockpits of the F-104B and F-104D were the same as for the F-104A and F-104C respectively. These are illustrated on page 15 for the F-104A and page 18 for the F-104C.

TYPICAL FORWARD COCKPIT - LEFT SIDE B



1	THUNDERSTORM LIGHT
2	ANTI-G SUIT VALVE
3	SPOTLIGHT
4	FLOODLIGHT (2)
5	TRIM AND STABILITY CONTROL PANEL
6	FUEL CONTROL PANEL
7	AUXILIARY TRIM CONTROL PANEL
8	THROTTLE QUADRANT
9	EXHAUST NOZZLE CONTROL SWITCH 3B
10	FORWARD PANEL
11	UHF COMMAND CONTROL PANEL (AN/ARC-66)
12	TACAN CONTROL PANEL (C-1763/ARN-21)
13	ID-249 CDI SELECTOR SWITCH
14	AUTO-PITCH CUTOUT PANEL
15	MISSILE CONTROL PANEL
16	VHF AND UHF CONTROL TRANSFER PANEL
17	GROUND TEST PANEL
18	CIRCUIT BREAKER PANEL

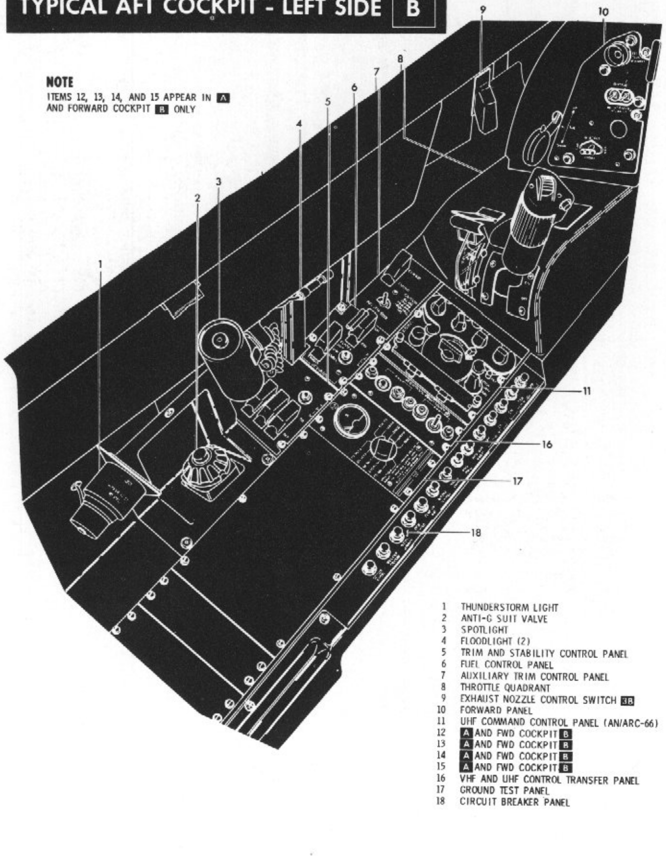
TYPICAL FORWARD COCKPIT - RIGHT SIDE B



1	FORWARD PANEL
2	ENGINE OIL PRESSURE RECORD CARD 3B
3	FRESH AIR SCOOP LEVER
4	CANOPY INTERNAL LOCKING LEVER
5	PYLON TANKS EMPTY LIGHT
6	FACE PLATE HEAT RHEOSTAT
7	INTERPHONE CONTROL PANELS
8	FLOODLIGHT (2)
9	ENGINE MOTORING SWITCH
10	THUNDERSTORM LIGHTS SWITCH
11	VENTILATED SUIT BLOWER SWITCH
12	SPOTLIGHT
13	THUNDERSTORM LIGHT
14	COMPUTER
15	HEATING CONTROL PANEL
16	FUSE PANEL
17	CIRCUIT BREAKER PANEL
18	J-4 HEADING INDICATOR CONTROL PANEL
19	INTERIOR AND EXTERIOR LIGHTING CONTROL PANEL
20	IFF CONTROL PANELS
21	VHF NAVIGATION CONTROL PANEL
22	OXYGEN PANELS

TYPICAL AFT COCKPIT - LEFT SIDE B

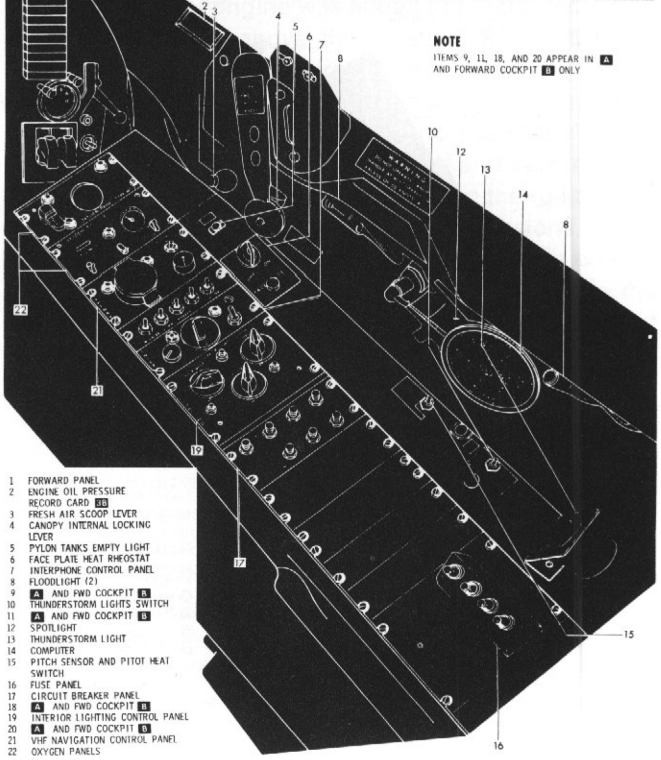
NOTE
ITEMS 12, 13, 14, AND 15 APPEAR IN A AND FORWARD COCKPIT B ONLY



1	THUNDERSTORM LIGHT
2	ANTI-G SUIT VALVE
3	SPOTLIGHT
4	FLOODLIGHT (2)
5	TRIM AND STABILITY CONTROL PANEL
6	FUEL CONTROL PANEL
7	AUXILIARY TRIM CONTROL PANEL
8	THROTTLE QUADRANT
9	EXHAUST NOZZLE CONTROL SWITCH 3B
10	FORWARD PANEL
11	UHF COMMAND CONTROL PANEL (AN/ARC-66)
12	A AND FWD COCKPIT B
13	A AND FWD COCKPIT B
14	A AND FWD COCKPIT B
15	A AND FWD COCKPIT B
16	VHF AND UHF CONTROL TRANSFER PANEL
17	GROUND TEST PANEL
18	CIRCUIT BREAKER PANEL

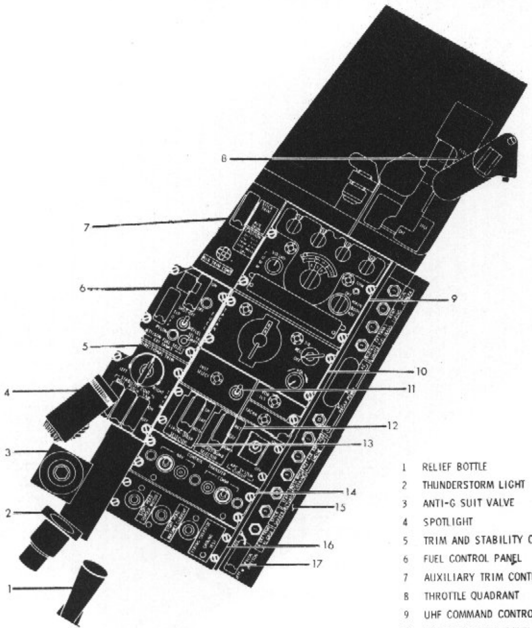
TYPICAL AFT COCKPIT - RIGHT SIDE B

NOTE
ITEMS 9, 11, 18, AND 20 APPEAR IN A AND FORWARD COCKPIT B ONLY



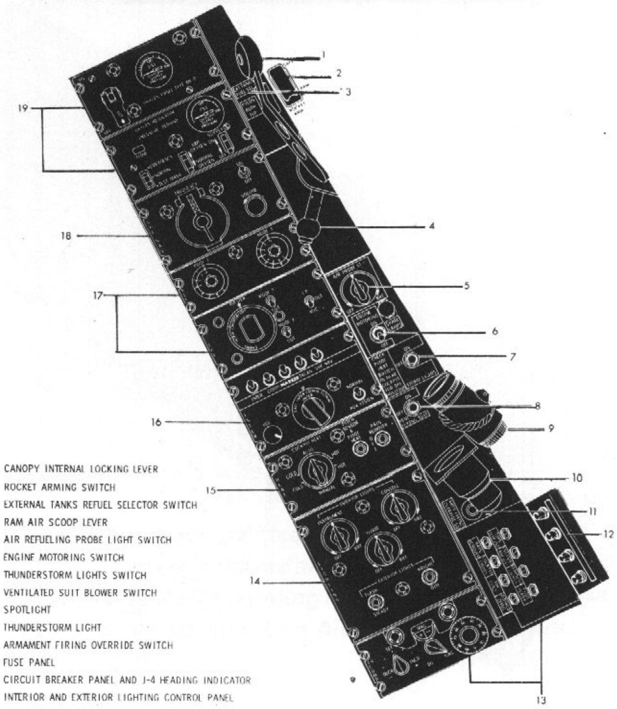
1	FORWARD PANEL
2	ENGINE OIL PRESSURE RECORD CARD 3B
3	FRESH AIR SCOOP LEVER
4	CANOPY INTERNAL LOCKING LEVER
5	PYLON TANKS EMPTY LIGHT
6	FACE PLATE HEAT RHEOSTAT
7	INTERPHONE CONTROL PANEL
8	FLOODLIGHT (2)
9	A AND FWD COCKPIT B
10	THUNDERSTORM LIGHTS SWITCH
11	A AND FWD COCKPIT B
12	SPOTLIGHT
13	THUNDERSTORM LIGHT
14	COMPUTER
15	PITCH SENSOR AND PITOT HEAT SWITCH
16	FUSE PANEL
17	CIRCUIT BREAKER PANEL
18	A AND FWD COCKPIT B
19	INTERIOR LIGHTING CONTROL PANEL
20	A AND FWD COCKPIT B
21	VHF NAVIGATION CONTROL PANEL
22	OXYGEN PANELS

TYPICAL FORWARD COCKPIT - LEFT SIDE Ⓓ



1 RELIEF BOTTLE
2 THUNDERSTORM LIGHT
3 ANTI-G SUIT VALVE
4 SPOTLIGHT
5 TRIM AND STABILITY CONTROL PANEL
6 FUEL CONTROL PANEL
7 AUXILIARY TRIM CONTROL PANEL
8 THROTTLE QUADRANT
9 UHF COMMAND CONTROL PANEL (AN/ARC-66)
10 TACAN CONTROL PANEL (C1763/ARN-21)
11 ID-249 CDI SELECTOR SWITCH
12 ROCKET/BOMB SELECTOR SWITCH
13 FIRING-DROP SELECTOR SWITCH
14 VHF AND UHF CONTROL TRANSFER PANEL
15 CIRCUIT BREAKER PANEL
16 GROUND TEST PANEL
17 PYLON JETTISON SWITCH

TYPICAL FORWARD COCKPIT - RIGHT SIDE Ⓓ

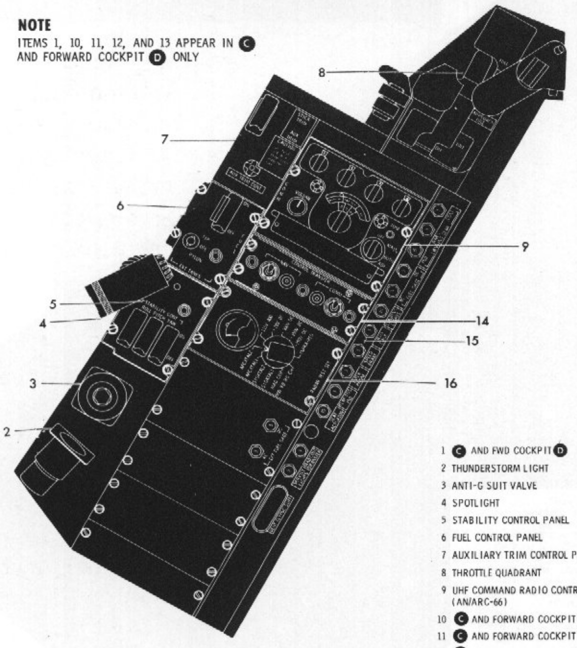


1 CANOPY INTERNAL LOCKING LEVER
2 ROCKET ARMING SWITCH
3 EXTERNAL TANKS REFUEL SELECTOR SWITCH
4 RAM AIR SCOOP LEVER
5 AIR REFUELING PROBE LIGHT SWITCH
6 ENGINE MOTORING SWITCH
7 THUNDERSTORM LIGHTS SWITCH
8 VENTILATED SUIT BLOWER SWITCH
9 SPOTLIGHT
10 THUNDERSTORM LIGHT
11 ARMAMENT FIRING OVERRIDE SWITCH
12 FUSE PANEL
13 CIRCUIT BREAKER PANEL AND J-4 HEADING INDICATOR
14 INTERIOR AND EXTERIOR LIGHTING CONTROL PANEL
15 HEATING CONTROL PANEL
16 INTERPHONE CONTROL PANEL
17 IFF/SIF CONTROL PANELS
18 VHF NAVIGATION CONTROL PANEL
19 OXYGEN PANELS

TYPICAL AFT COCKPIT - LEFT SIDE Ⓓ

NOTE

ITEMS 1, 10, 11, 12, AND 13 APPEAR IN Ⓒ AND FORWARD COCKPIT Ⓓ ONLY

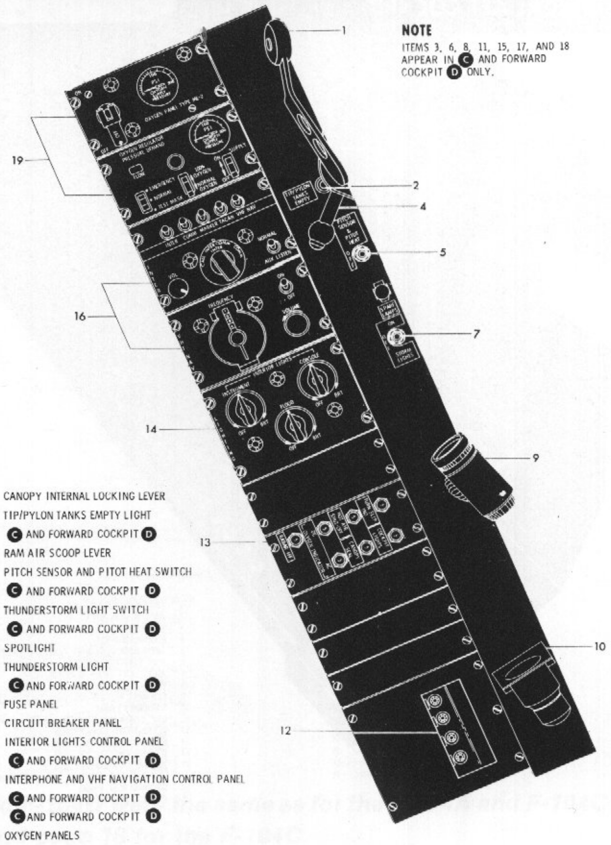


1 Ⓒ AND FWD COCKPIT Ⓓ
2 THUNDERSTORM LIGHT
3 ANTI-G SUIT VALVE
4 SPOTLIGHT
5 STABILITY CONTROL PANEL
6 FUEL CONTROL PANEL
7 AUXILIARY TRIM CONTROL PANEL
8 THROTTLE QUADRANT
9 UHF COMMAND RADIO CONTROL PANEL (AN/ARC-66)
10 Ⓒ AND FORWARD COCKPIT Ⓓ
11 Ⓒ AND FORWARD COCKPIT Ⓓ
12 Ⓒ AND FORWARD COCKPIT Ⓓ
13 Ⓒ AND FORWARD COCKPIT Ⓓ
14 VHF AND UHF CONTROL TRANSFER PANEL
15 CIRCUIT BREAKER PANEL
16 TEST PANEL

TYPICAL AFT COCKPIT-RIGHT SIDE Ⓓ

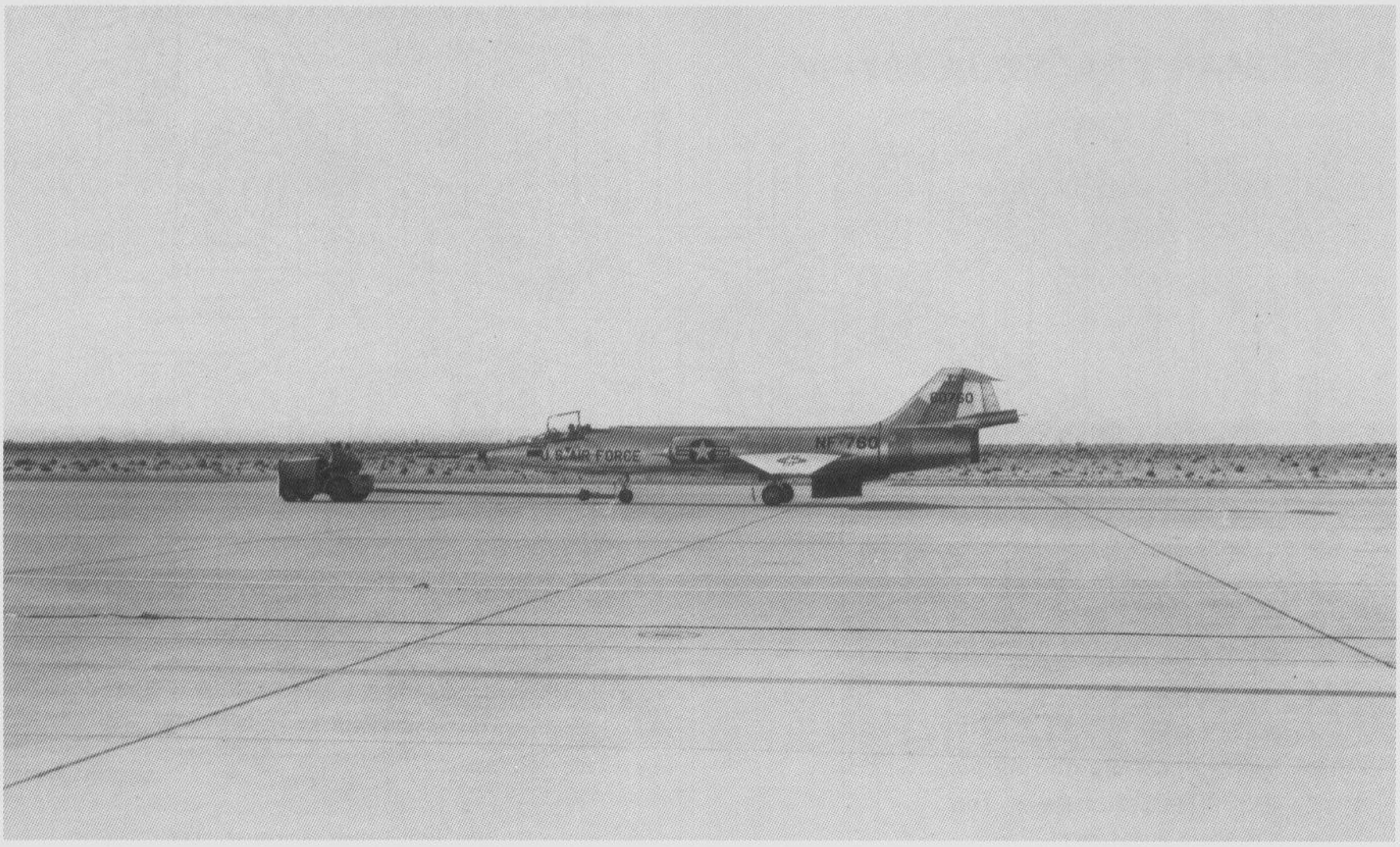
NOTE

ITEMS 3, 6, 8, 11, 15, 17, AND 18 APPEAR IN Ⓒ AND FORWARD COCKPIT Ⓓ ONLY.

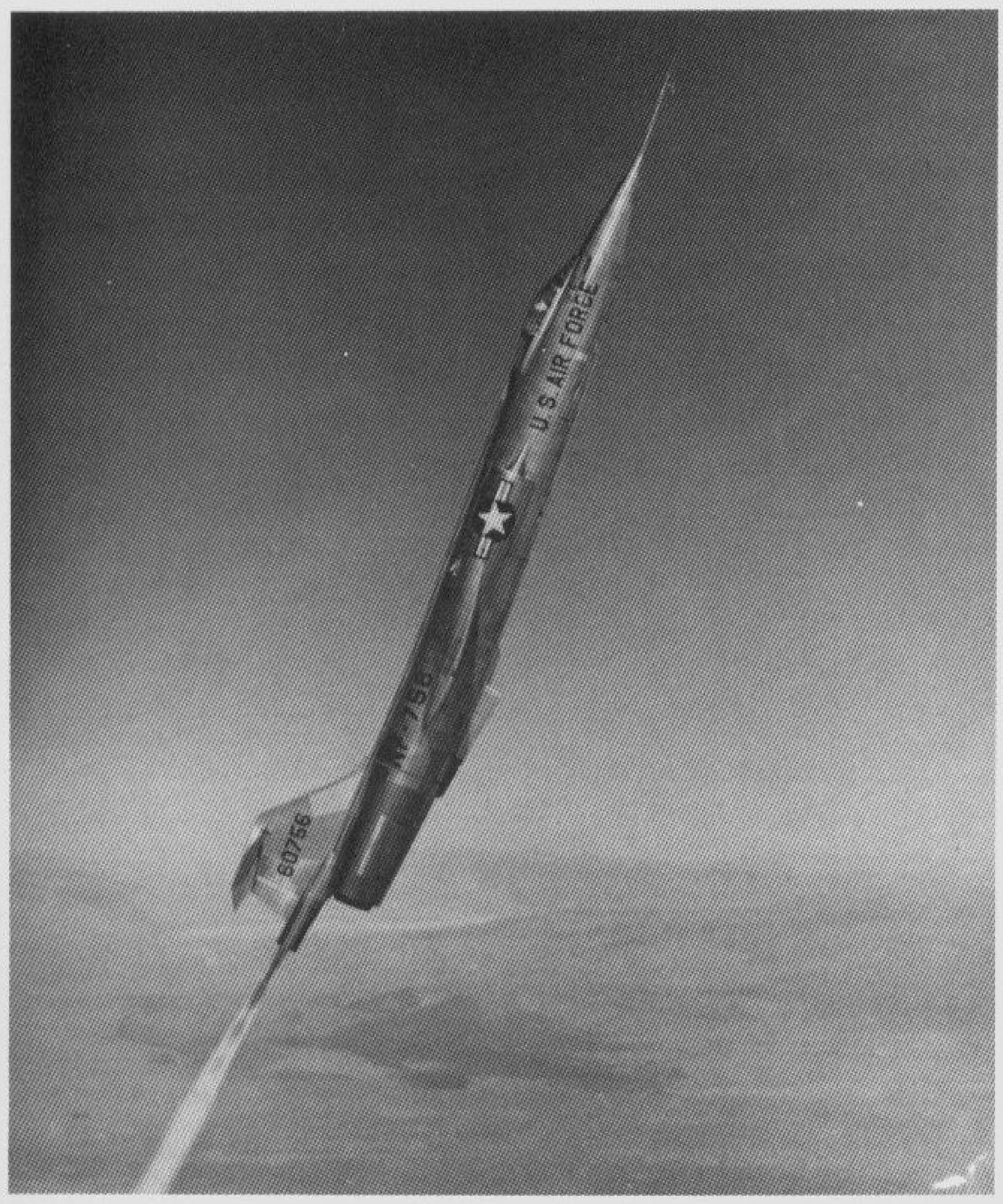


1. CANOPY INTERNAL LOCKING LEVER
2. TIP/PYLON TANKS EMPTY LIGHT
3. Ⓒ AND FORWARD COCKPIT Ⓓ
4. RAM AIR SCOOP LEVER
5. PITCH SENSOR AND PITOT HEAT SWITCH
6. Ⓒ AND FORWARD COCKPIT Ⓓ
7. THUNDERSTORM LIGHT SWITCH
8. Ⓒ AND FORWARD COCKPIT Ⓓ
9. SPOTLIGHT
10. THUNDERSTORM LIGHT
11. Ⓒ AND FORWARD COCKPIT Ⓓ
12. FUSE PANEL
13. CIRCUIT BREAKER PANEL
14. INTERIOR LIGHTS CONTROL PANEL
15. Ⓒ AND FORWARD COCKPIT Ⓓ
16. INTERPHONE AND VHF NAVIGATION CONTROL PANEL
17. Ⓒ AND FORWARD COCKPIT Ⓓ
18. Ⓒ AND FORWARD COCKPIT Ⓓ
19. OXYGEN PANELS

NF-104



Three F-104As, 56-756, 56-760, and 56-762, were modified to NF-104s with the addition of a Rocketdyne AR-2 rocket motor and other changes. Here, 56-760 gets a tow at Edwards Air Force Base. The rocket motor can be seen under the enlarged tail fin. ***(Flightleader)***

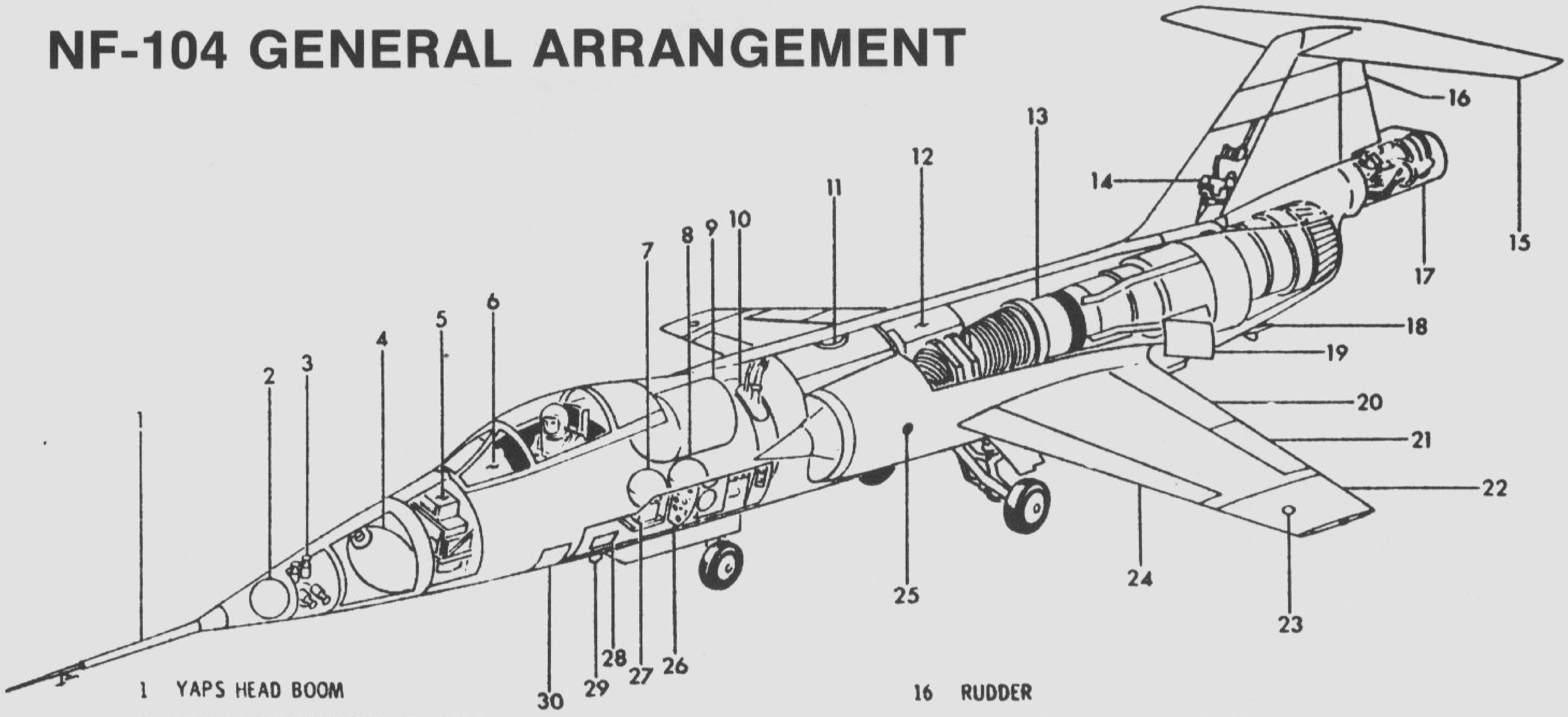


NF-104, 56-756, is shown here climbing with the rocket motor adding thrust to boost the aircraft to altitudes as high as 140,000 feet. ***(USAF via Jones)***

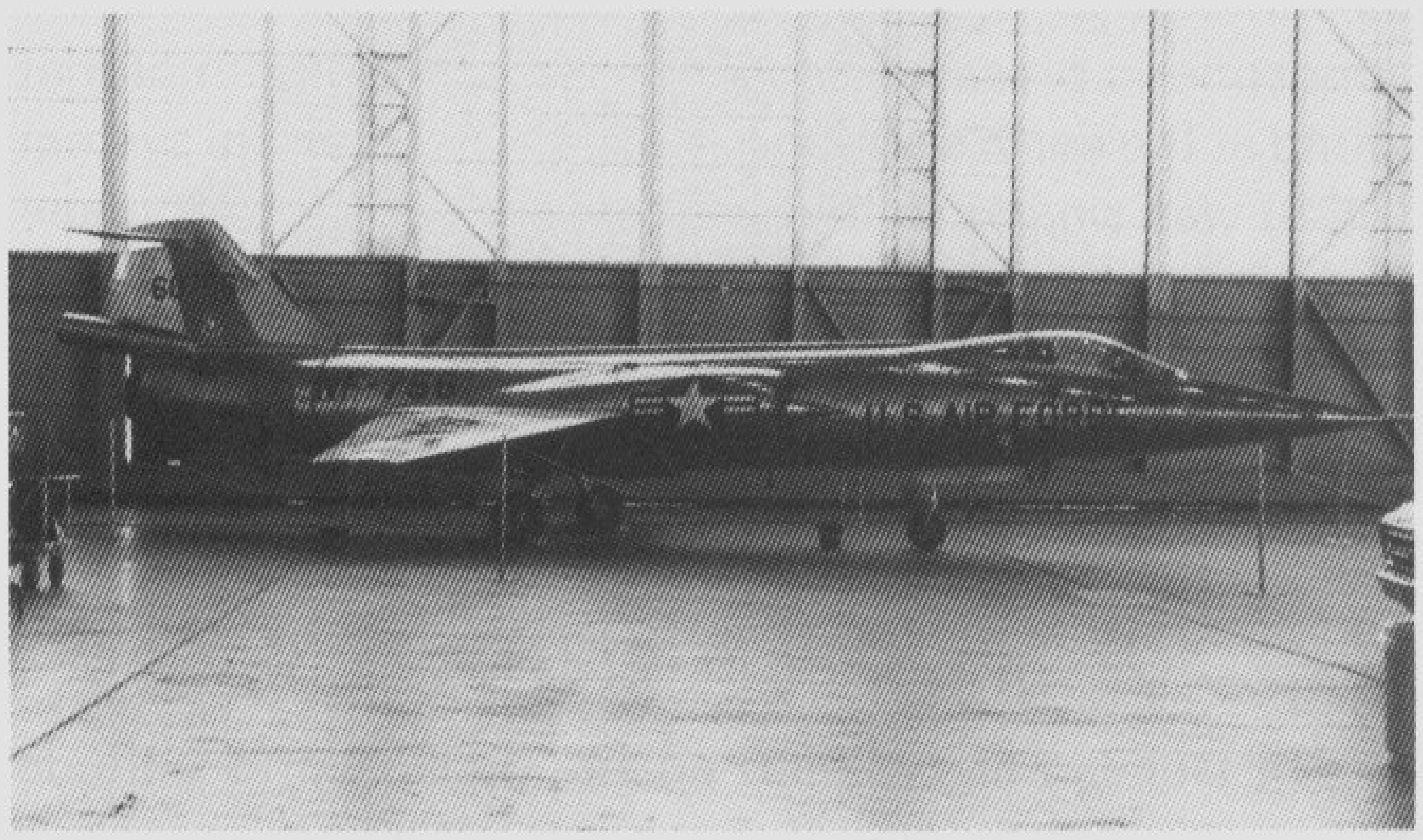
Three F-104As, 56-756, 56-760, and 56-762 were modified to be used as aerospace trainers. An LR-121/AR-2 liquid fuel rocket engine was added to the tail section of these aircraft just above the exhaust. It added 6,640 pounds of thrust to the aircraft which weighed 22,000 pounds when fully serviced. The vertical tail was enlarged to the size used on the F-104G, and the shape of the intake cones was also modified. Pitch and yaw reaction control jets were placed in the nose, and the roll control jets were located in twenty-four inch extensions on the wing tips. These jets used hydrogen peroxide to control the aircraft at altitudes up to 120,000 feet where the atmospheric pressure is only one-one hundredth of that found at the earth's surface. This reaction control system (RCS) was similar to that used on the X-15 rocket plane and manned spacecraft. The idea was to give potential astronauts a low cost trainer that would provide them the opportunity to control the aircraft at altitudes where conventional control surfaces would not be effective. The flight also provided about one minute of zero-gravity conditions as the aircraft flew a ballistic arc at the high point of its flight.

On December 6, 1943, an unofficial world altitude record was set by one of these aircraft when it reached 120,000 feet. The three NF-104s served with the Aerospace Research Pilot School at Edwards AFB, California. Many of the nation's future astronauts used the aircraft as part of their intensive training program.

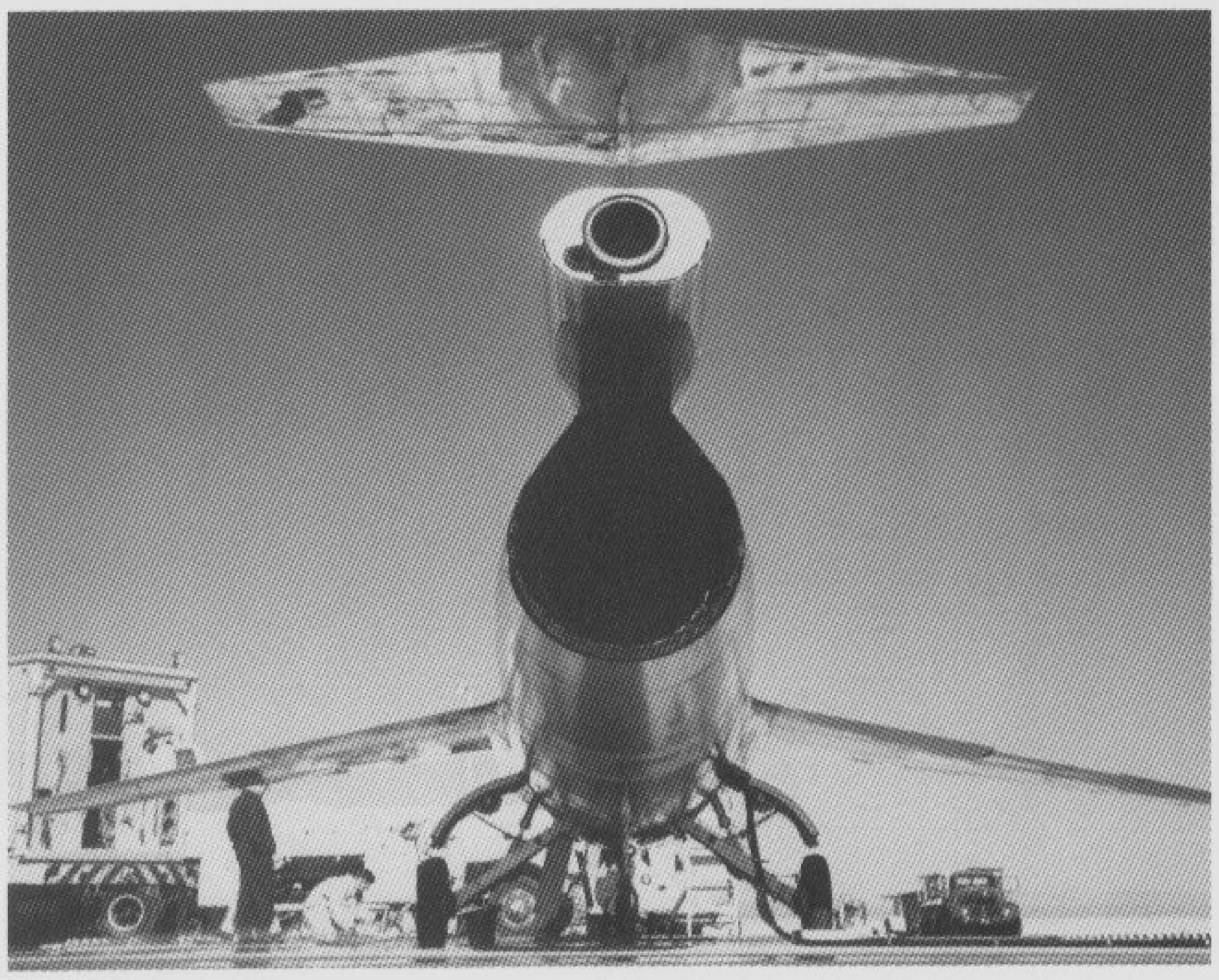
NF-104 GENERAL ARRANGEMENT



1 YAPS HEAD BOOM
2 RCS PRESSURIZATION GN_2 TANK
3 RCS PITCH AND YAW MOTORS (EIGHT)
4 RCS H_2O_2 TANK
5 OSCILLOGRAPH
6 ELECTRICALLY HEATED WINDSHIELD
7 COCKPIT PRESSURIZATION GN_2 TANK
8 H_2O_2 PRESSURIZATION GN_2 TANK
9 FORWARD H_2O_2 TANK
10 AFT H_2O_2 TANK
11 FORWARD MAIN JP-4 FUEL TANK
12 AFT MAIN JP-4 FUEL TANK
13 J79-GE-3B TURBOJET ENGINE WITH AFTERBURNER
14 HORIZONTAL STABILIZER POWER CONTROL ASSEMBLY
15 CONTROLLABLE HORIZONTAL STABILIZER
16 RUDDER
17 MODIFIED LR 121-NA-1 ROCKET ENGINE
18 DRAG CHUTE DOOR
19 SPEED BRAKE
20 TRAILING EDGE FLAP
21 AILERON
22 WING TIP EXTENSION
23 RCS ROLL MOTOR (TWO EACH WING TIP)
24 LEADING EDGE FLAP
25 NAVIGATION LIGHTS (SIX)
26 AUTOMATIC OBSERVER (AO) PANEL
27 THIRTY-FOUR-AMPER-HOUR BATTERY
28 UHF RECEIVER/TRANSMITTER
29 APW-11 TRANSMITTER ANTENNA
30 UHF ANTENNA



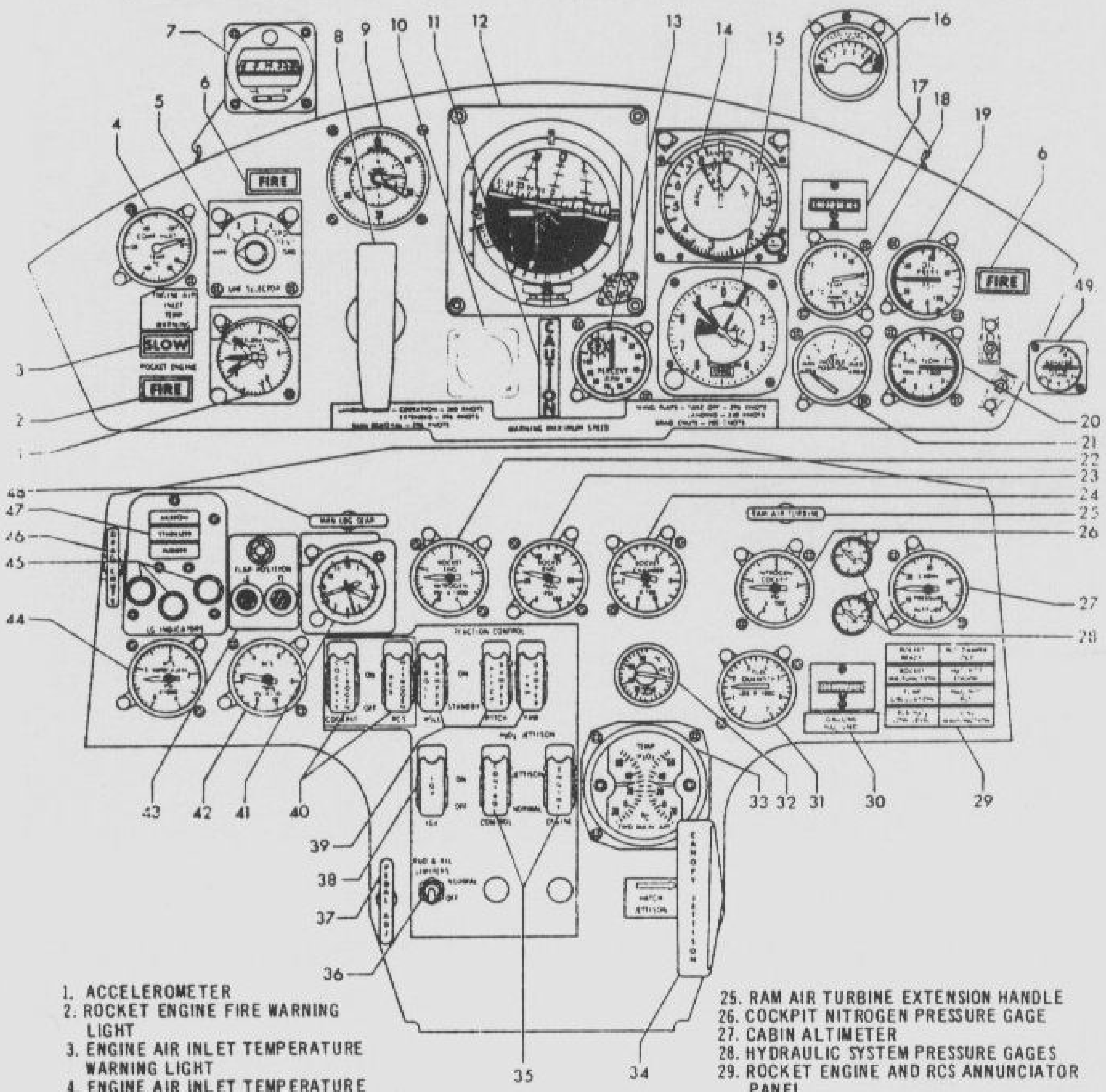
The markings on the right side of NF-756 are shown in this photograph of the aircraft that was taken in a hangar between flights. The markings were very basic and common to all three NF-104s. (MAP)



Details of the rocket motor can be seen in this view taken from directly behind the aircraft. Careful examination of this photograph will reveal the twenty-four inch extensions beyond the ailerons. These extensions house the reaction control jets that provide roll control in the thin air at very high altitudes. Reaction control jets for pitch and yaw control were housed in the nose.

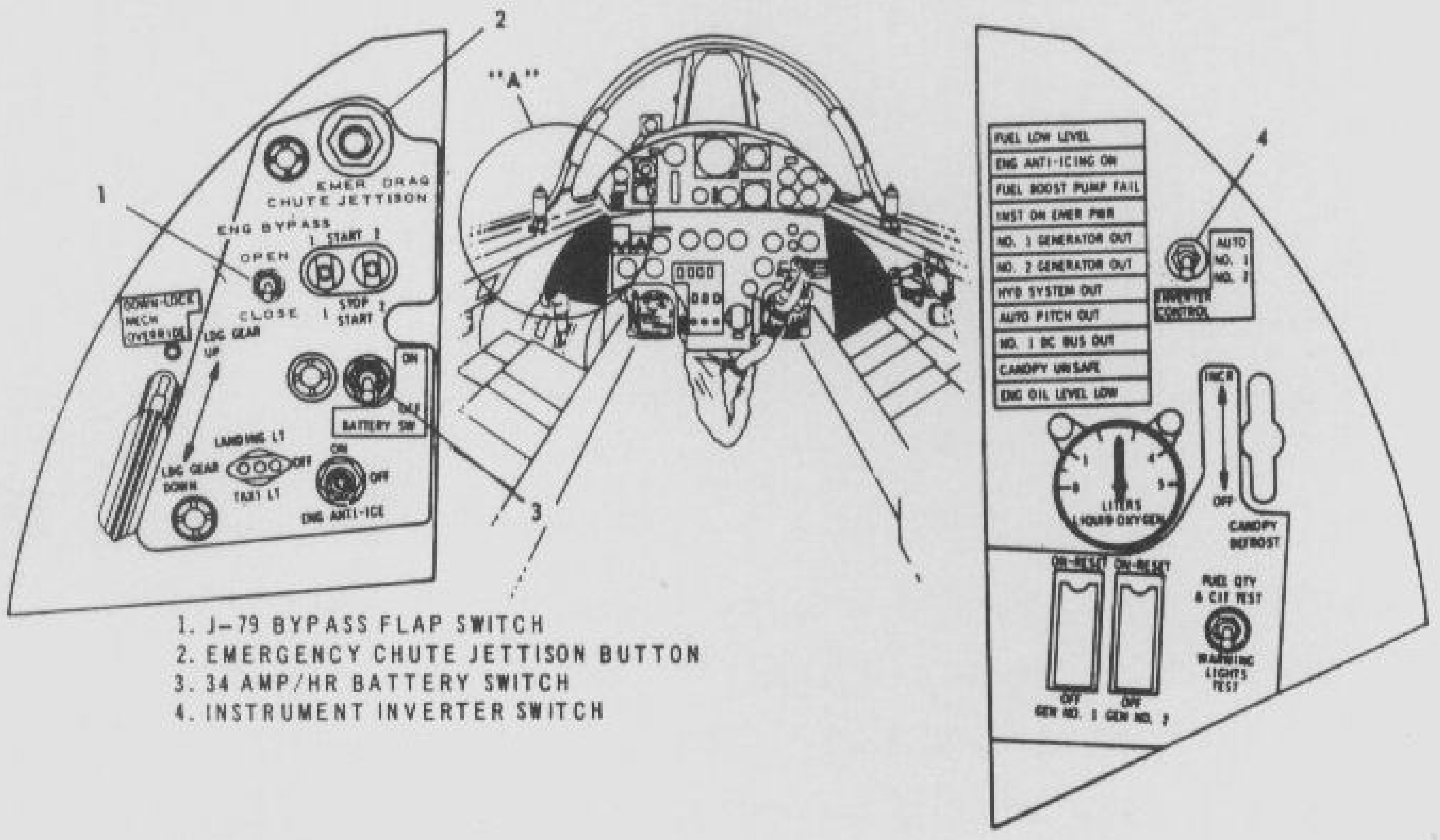
(USAF via Jones)

NF-104 INSTRUMENT PANEL



1. ACCELEROMETER
2. ROCKET ENGINE FIRE WARNING LIGHT
3. ENGINE AIR INLET TEMPERATURE WARNING LIGHT
4. ENGINE AIR INLET TEMPERATURE GAGE
5. UHF FREQUENCY SELECTOR
6. JET ENGINE FIRE WARNING LIGHT (TWO)
7. STANDBY COMPASS
8. RCS CONTROL HANDLE
9. ROCKET ENGINE TIMER
10. GROSS ANGLE OF ATTACK
11. MAXIMUM SPEED CAUTION LIGHT
12. AARS INDICATOR
13. JET ENGINE TACHOMETER
14. AIRSPEED INDICATOR
15. HIGH ALTITUDE ALTIMETER
16. AUTOPITCH CONTROL INDICATOR
17. CORRELATION COUNTER
18. EGT GAGE
19. OIL PRESSURE GAGE
20. FUEL FLOW INDICATOR
21. EXHAUST NOZZLE POSITION INDICATOR
22. ROCKET ENGINE NITROGEN PRESSURE GAGE
23. ROCKET ENGINE H_2O_2 PRESSURE GAGE
24. ROCKET CHAMBER PRESSURE GAGE
25. RAM AIR TURBINE EXTENSION HANDLE
26. COCKPIT NITROGEN PRESSURE GAGE
27. CABIN ALTIMETER
28. HYDRAULIC SYSTEM PRESSURE GAGES
29. ROCKET ENGINE AND RCS ANNUNCIATOR PANEL
30. H_2O_2 FLOW COUNTER
31. JP-4 FUEL QUANTITY GAGE
32. RCS H_2O_2 TEMPERATURE GAGE
33. ROCKET ENGINE FORWARD AND AFT H_2O_2 TEMPERATURE GAGE
34. CANOPY JETTISON HANDLE
35. CONTROL (RCS) ROCKET ENGINE H_2O_2 JETTISON SWITCHES
36. RUDDER AND AILERON LIMITER SWITCH
37. RUDDER PEDAL ADJUSTMENT HANDLE
38. IGV SWITCH
39. RCS DAMPER CONTROL SWITCHES
40. RCS AND COCKPIT NITROGEN SWITCHES
41. CLOCK
42. RCS H_2O_2 PRESSURE GAGE
43. WING FLAP POSITION INDICATORS
44. RCS NITROGEN PRESSURE GAGE
45. LANDING GEAR POSITION INDICATOR LIGHTS
46. DRAG CHUTE HANDLE
47. AILERON, STABILIZER, AND RUDDER TAKEOFF TRIM INDICATOR LIGHTS
48. MANUAL LANDING GEAR RELEASE HANDLE
49. STABILIZER (ELEVATOR) POSITION INDICATOR

NF-104 AUXILIARY PANELS



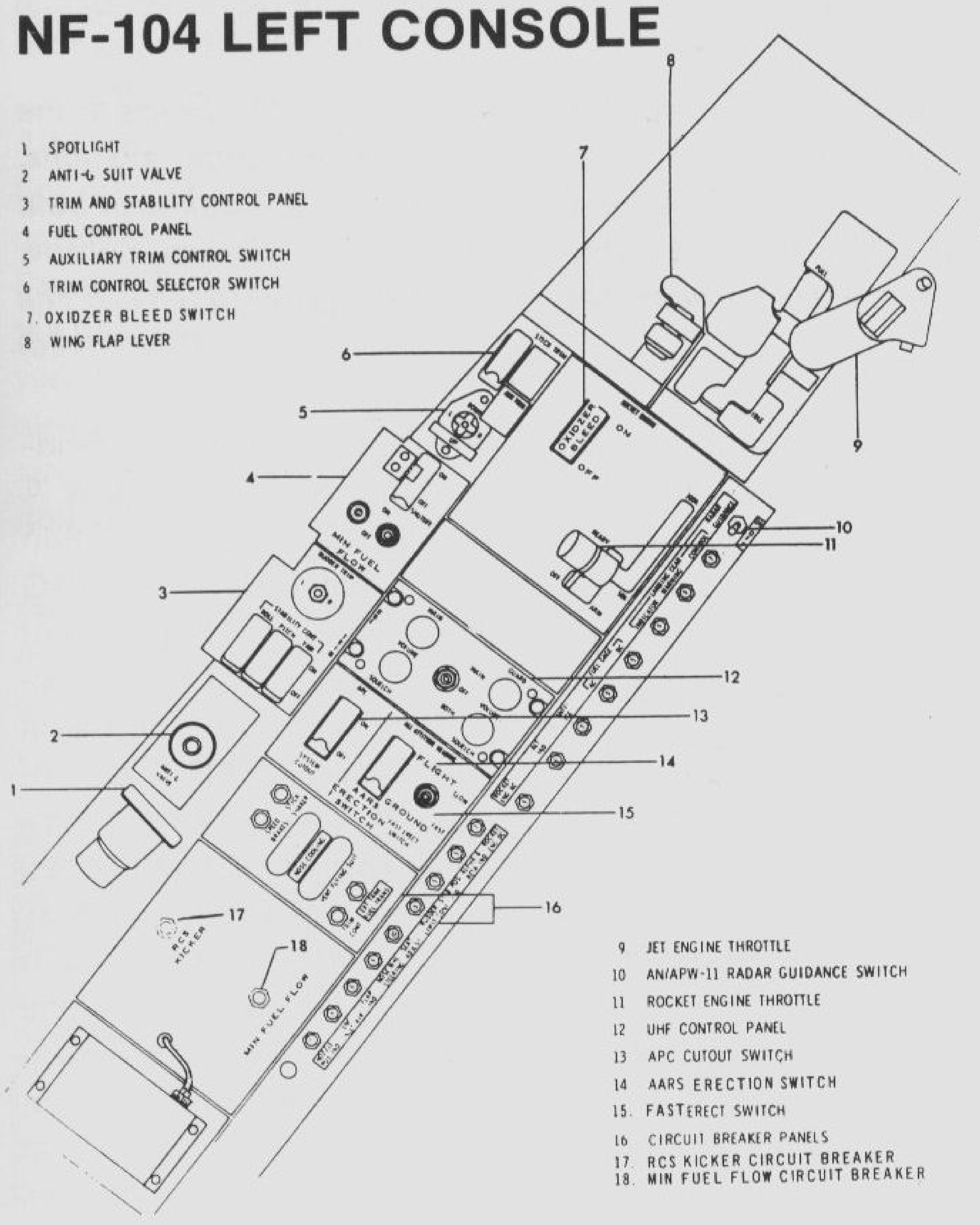
1. J-79 BYPASS FLAP SWITCH
2. EMERGENCY CHUTE JETTISON BUTTON
3. 34 AMP/HR BATTERY SWITCH
4. INSTRUMENT INVERTER SWITCH

NF-104

COCKPIT

DETAILS

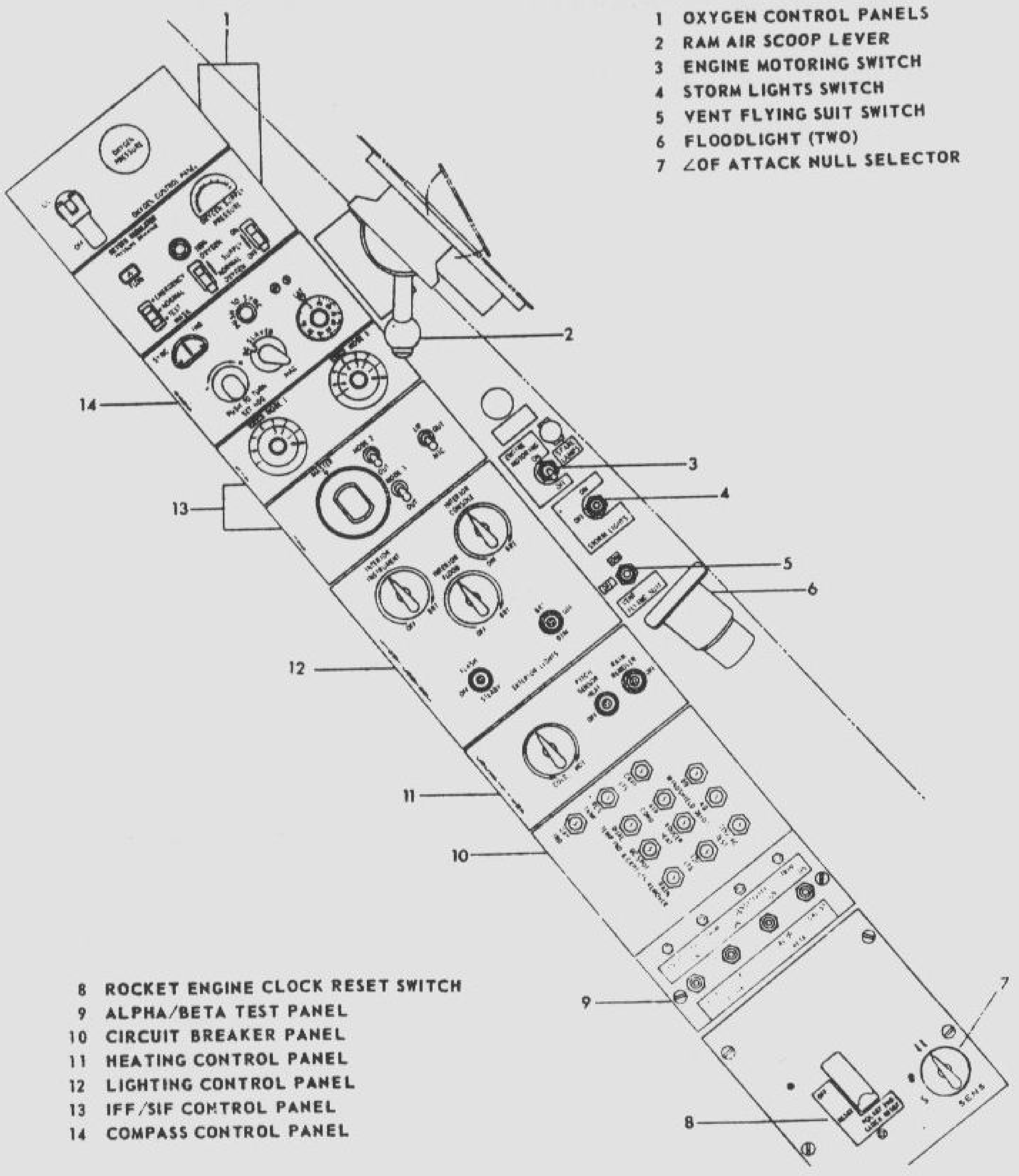
NF-104 LEFT CONSOLE



1 SPOTLIGHT
2 ANTI-G SUIT VALVE
3 TRIM AND STABILITY CONTROL PANEL
4 FUEL CONTROL PANEL
5 AUXILIARY TRIM CONTROL SWITCH
6 TRIM CONTROL SELECTOR SWITCH
7. OXIDZER BLEED SWITCH
8 WING FLAP LEVER

9 JET ENGINE THROTTLE
10 AN/APW-11 RADAR GUIDANCE SWITCH
11 ROCKET ENGINE THROTTLE
12 UHF CONTROL PANEL
13 APC CUTOUT SWITCH
14 AARS ERECTION SWITCH
15. FASTERECT SWITCH
16 CIRCUIT BREAKER PANELS
17. RCS KICKER CIRCUIT BREAKER
18. MIN FUEL FLOW CIRCUIT BREAKER

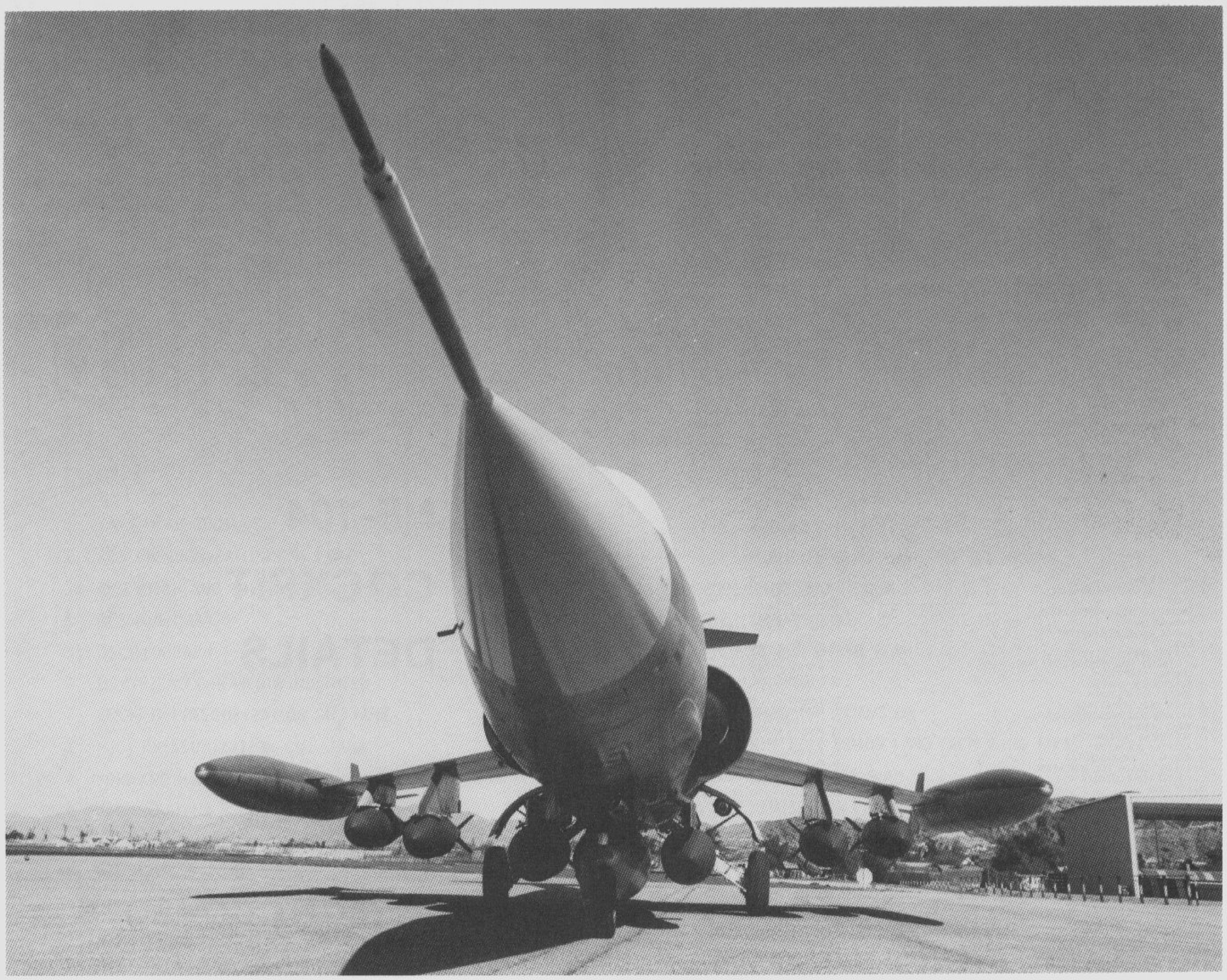
NF-104 RIGHT CONSOLE



1 OXYGEN CONTROL PANELS
2 RAM AIR SCOOP LEVER
3 ENGINE MOTORING SWITCH
4 STORM LIGHTS SWITCH
5 VENT FLYING SUIT SWITCH
6 FLOODLIGHT (TWO)
7 ∠OF ATTACK NULL SELECTOR

8 ROCKET ENGINE CLOCK RESET SWITCH
9 ALPHA/BETA TEST PANEL
10 CIRCUIT BREAKER PANEL
11 HEATING CONTROL PANEL
12 LIGHTING CONTROL PANEL
13 IFF/SIF CONTROL PANEL
14 COMPASS CONTROL PANEL

FOREIGN STARFIGHTERS

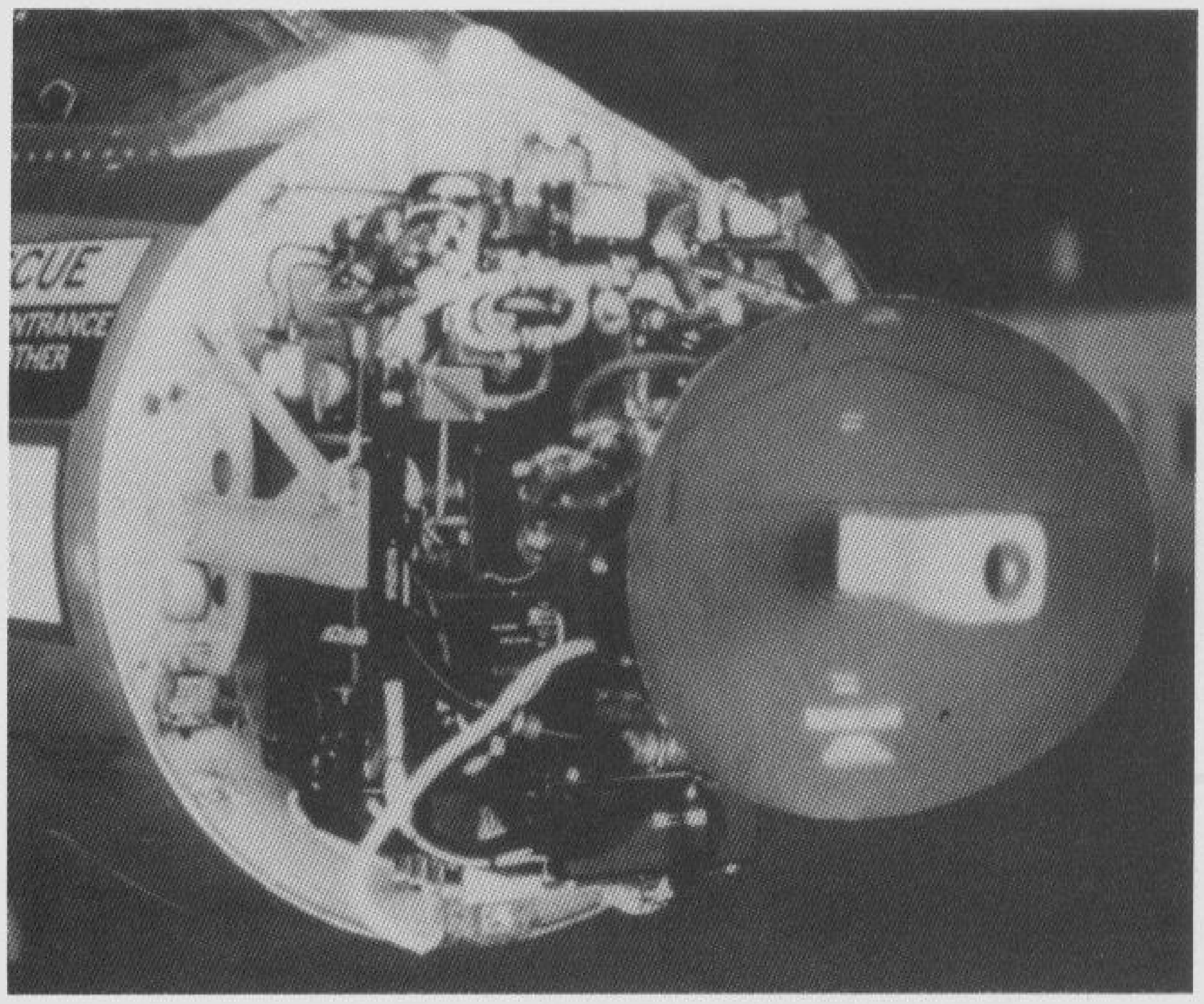


Although the F-104 was not used in large numbers by the U.S. Air Force, it was quite another story elsewhere in the world. By modifying the airframe to carry more external stores, and by changing the avionics and other systems, Lockheed was able to turn the Starfighter into a credible fighter-bomber. Beginning with the F-104G, Lockheed built many Starfighters for foreign use, and licensed the rights to build even more aircraft to companies in Canada, Europe, and Japan. In the 1960s and early 1970s, the F-104 was used in greater numbers than any other fighter in NATO. The ultimate example was the F-104S, which was built in Italy. ***(Lockheed)***

Although Lockheed could not claim any great success for the Starfighter with the U.S. Air Force, it was a different matter when it came to many other foreign nations. It began on November 6, 1958, when West Germany selected the F-104 as its new fighter aircraft. Lockheed had agreed to make changes to the airframe that would allow the German version to serve as an interceptor, fighter-bomber, and reconnaissance aircraft.

On March 18, 1959, the first contracts were signed with West Germany that included an order for thirty F-104F two-seat trainers that were essentially the same as the F-104D built for the U.S. Air Force. Also included were sixty-six F-104Gs, which were to become the first of the upgraded fighter aircraft. These aircraft were initially produced by Lockheed at Burbank, California, but soon production began in Europe.

To meet German requirements, the Starfighter's airframe was strengthened in the fuselage, wings, and landing gear to allow it to operate at higher gross weights. A new electronics suite, including a fully-automatic Litton LN-3 internal navigation system, provided the F-104G with an all-weather navigation capability that did not require any reference to ground stations. A TACAN system for radio navigation was also installed. The North American Search and Ranging Radar (NASARR), a compact but capable unit, provided all-weather fire control necessary for the often inclement weather experienced on the European continent. This fire control system, designated F-15AM-11, not only provided the pilot with information for air-to-air missions by computing lead angle and automatically firing the missiles at the optimum moment, but it was also used for all-weather bombing, navigation, contour mapping, and even terrain avoidance. Coupled with the gunsight, it also provided



The North American Search and Ranging Radar (NASARR) was installed in the F-104G. Similar, but slightly different versions of the NASARR were also fitted in the Canadian and Japanese Starfighters. Compare this unit to the radar used in the U.S. Air Force versions as illustrated on page 35. (Hebrok collection)

information for accurately firing the Vulcan cannon by computing the correct lead angle and displaying the proper line of sight information on the gunsight's glass. A bombing computer was also installed to aid in the delivery of free fall weapons using various attack profiles.

The J79-GE-11A engine, the most reliable version of the J79 yet placed in an F-104, was the powerplant chosen for the German fighter. The F-104G was called the "Super Starfighter."

In the air-to-air role, the F-104G could carry up to four AIM-9 Sidewinder missiles. Two were carried on the wing tips like on American aircraft, and two could also be carried on rails mounted under the forward fuselage. Project Grindstone had also added this capability to carry the fuselage-mounted Sidewinders to F-104Cs, but it was very seldom seen in use on USAF Starfighters. To carry air-to-ground weapons, additional hardpoints and stronger pylons were provided. The 20mm Vulcan cannon was retained as internal armament.

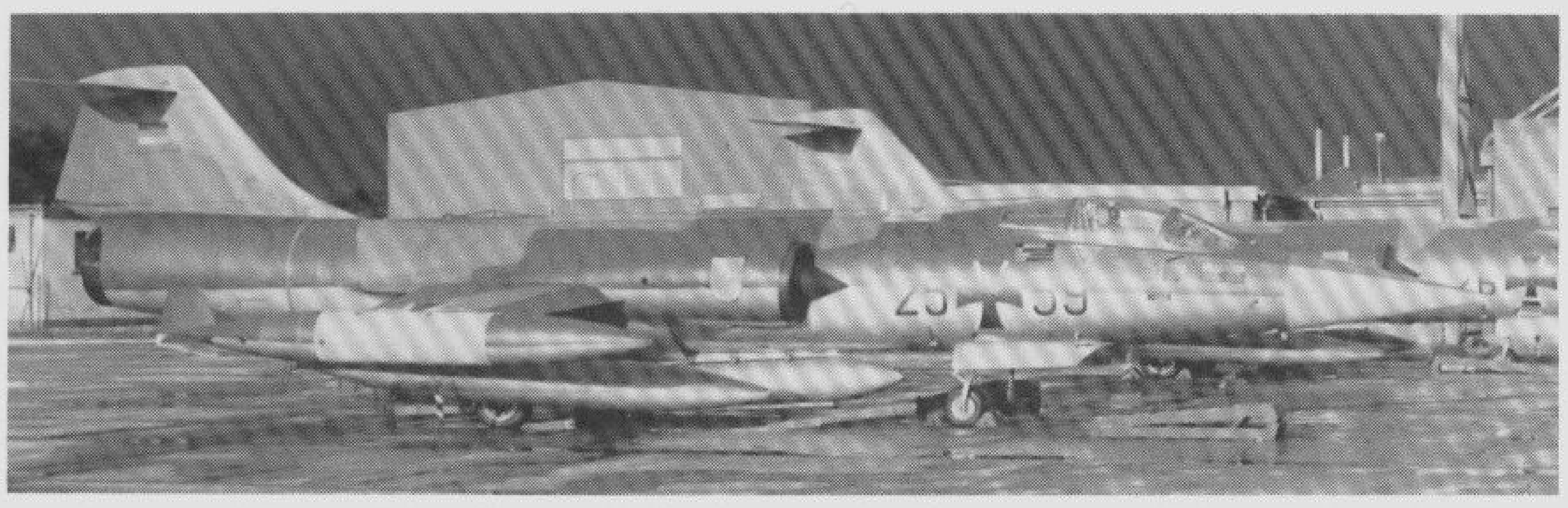
The first F-104G made its maiden flight on June 7, 1960. From outward appearances, it looked the same as the F-104C. However, there was one noticeable difference in the design. The vertical tail and rudder had been enlarged approximately twenty-five percent to the size used previously on the two-seat F-104B and F-104D, so the F-104G became the first single-seat F-104 to have these enlarged vertical tail surfaces. This would remain the same for all subsequent production aircraft. A stronger anti-skid braking system was added as was an anti-icing system for the intake lips. From the beginning, the F-104G was fitted with an upward-firing ejection seat. The Lockheed C-2 was selected at first, but West Germany later opted for the Martin-Baker Q5 seat.

On July 2, 1959, Lockheed finalized an agreement for Canadair to begin production of the Starfighter in Canada. The Netherlands signed their licensing agreement to build the F-104G on April 20, 1960, and Belgium followed on June 20. Production next moved to the other side of the world when Japan announced that it was going to build the F-104J and two-seat F-104DJ for the Japanese Air Self Defense Force. The F-104J was very similar to the F-104G, but was limited only to the air-to-air role as demanded by Japan's post-World War II constitution that prohibited an offensive weapons capability. Japan's Starfighters were built by Mitsubishi in cooperation with Kawasaki Aircraft, Ltd.

But the number of foreign nations producing and operating the F-104 was still growing. In March 1961, Italy announced that it would join in the production program building the F-104G. Starfighters were fast becoming the primary fighter in NATO's arsenal. In Europe, production sites were grouped according to geographical location and included three groups. The Northern Group included Fokker and Aviolanda in The Netherlands, and Focke-Wulf, Hamburger Flugzeugbau, and Westerflug in Germany. The South Group was comprised of Dornier, Heinkel, Messerschmitt, and Siebel in Germany. The West Group combined SABCA and Avions Fairey in Belgium with Fiat and other Italian companies. Two-seat aircraft were built from parts manufactured by Lockheed and assembled with other parts in Europe. Canadair also built 140 F-104Gs after completing production of CF-104s for the Canadian Armed Forces.

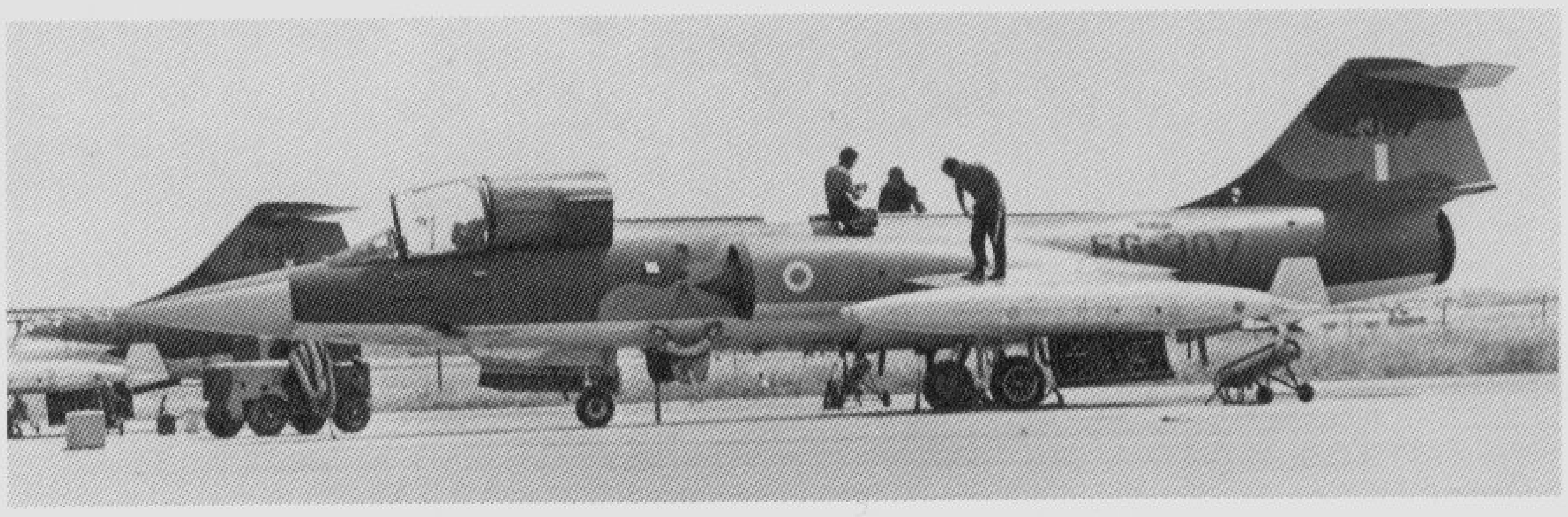
The TF-104G was the two-seat trainer version of the F-104G, but it lacked the Vulcan cannon and autopilot of the F-104G. Although it could carry some external ordnance, it fell short of the capability of the F-104G. Like the F-104B and F-104D, it had a nose gear that retracted to the rear from the forward end of the nose gear well.

Some F-104Gs were modified to carry cameras in the forward fuselage section. To make room for the cameras, the Vulcan cannon was not installed, and these RF-104Gs

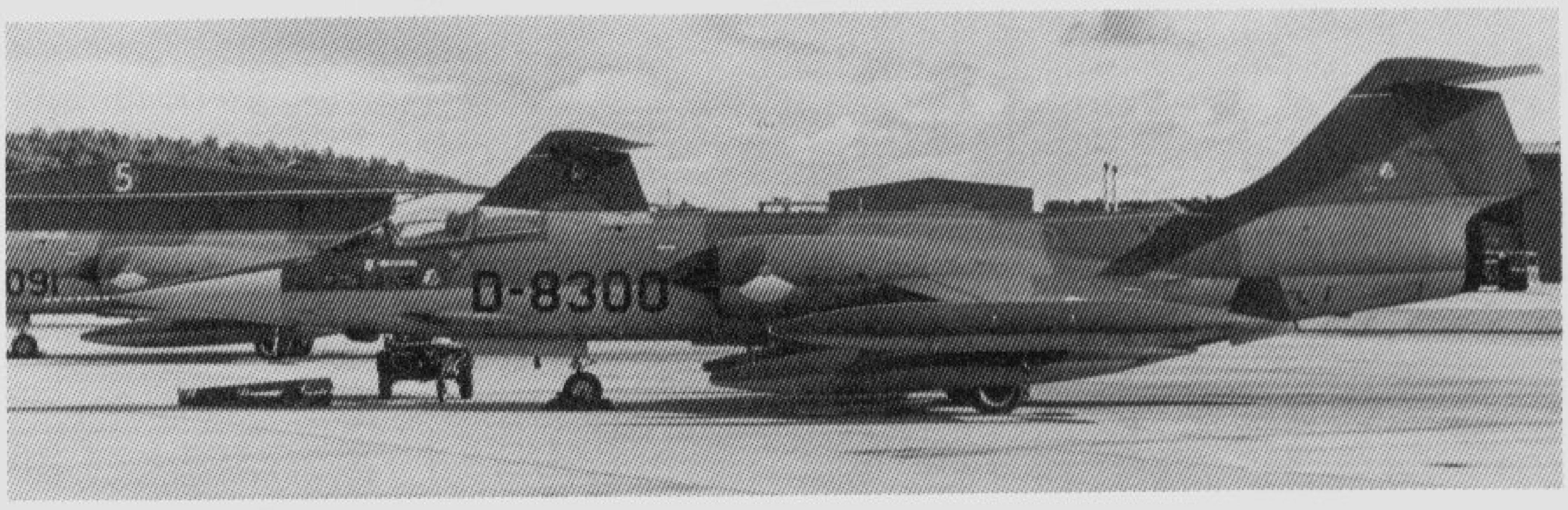


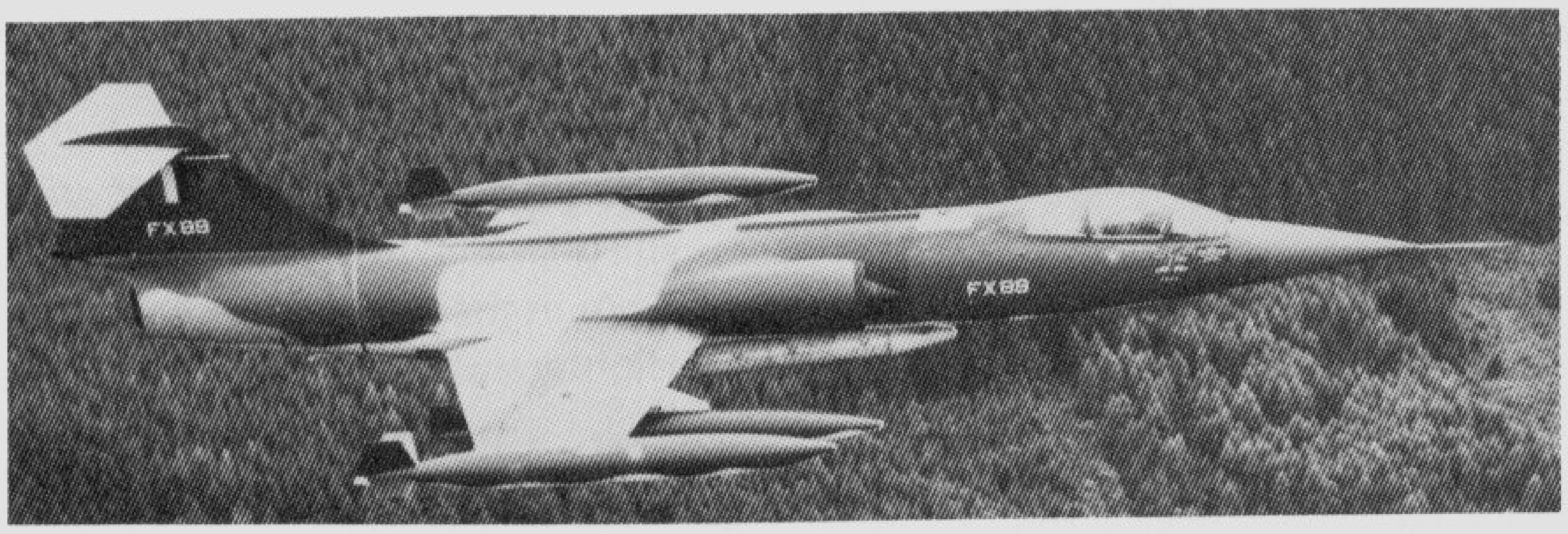
This is an F-104G in the colors and markings of the German Air Force. This variant of the Starfighter had the enlarged vertical tail and rudder as did all F-104s built for foreign service. (MAP)

The photographs on this page illustrate F-104Gs in the markings of some of the countries that operated this version of the Starfighter. This F-104G is shown in the markings of the Greek Air Force. (MAP)



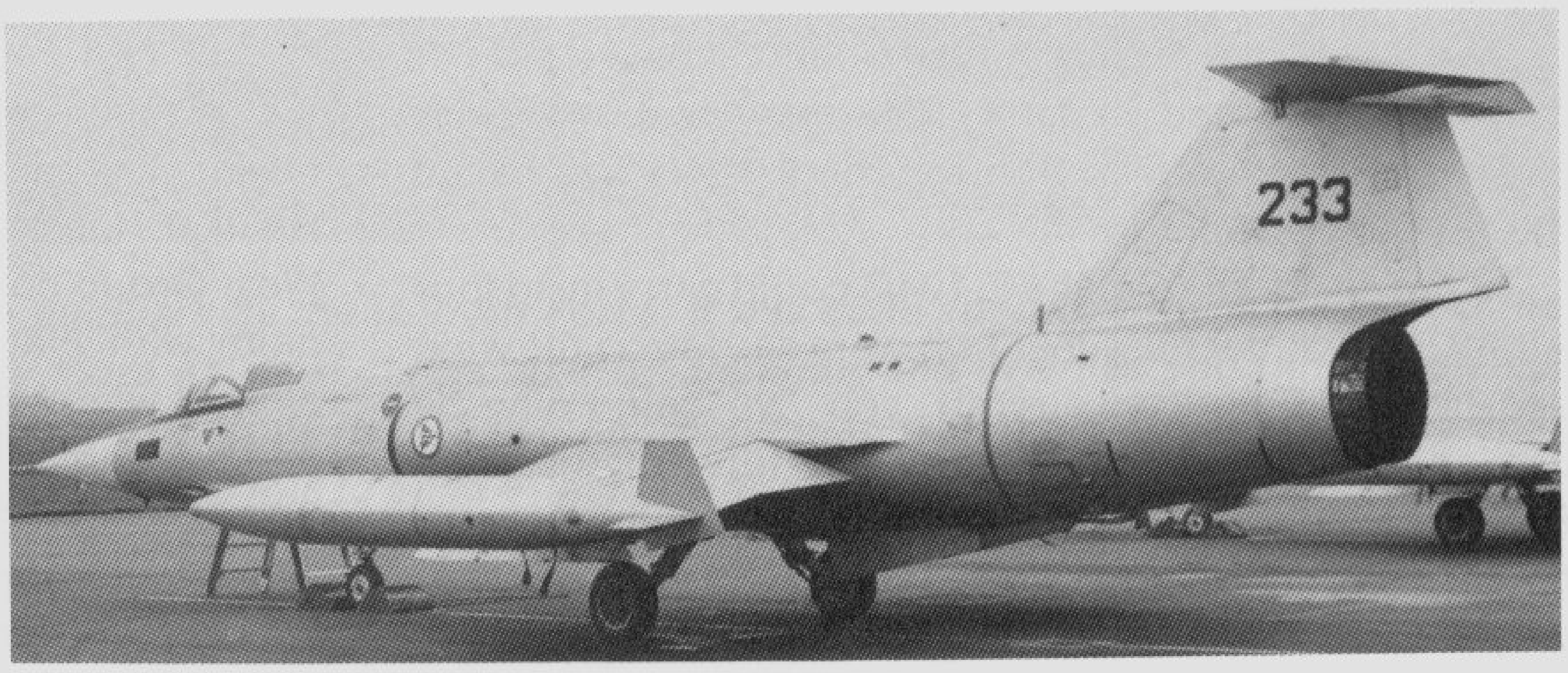
The F-104G was also operated by The Netherlands. Dutch Starfighters often used the same camouflage scheme as German aircraft. (MAP)

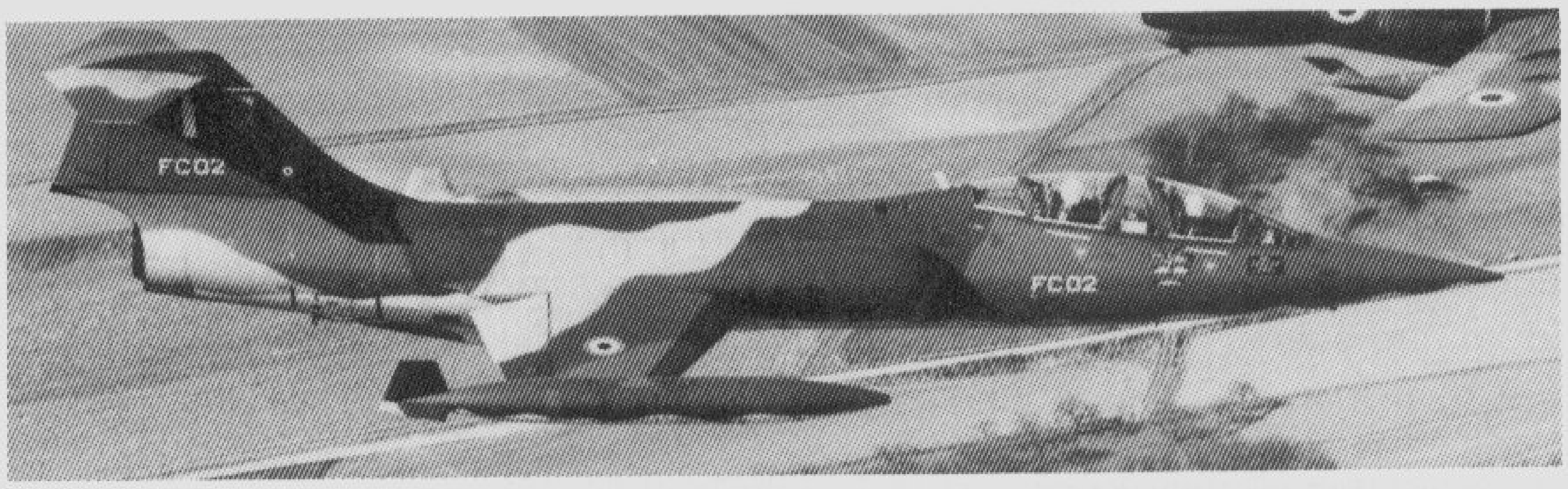




The camouflage scheme on this Belgian F-104G is very much like the standard camouflage scheme used on U.S. Starfighters. (MAP)

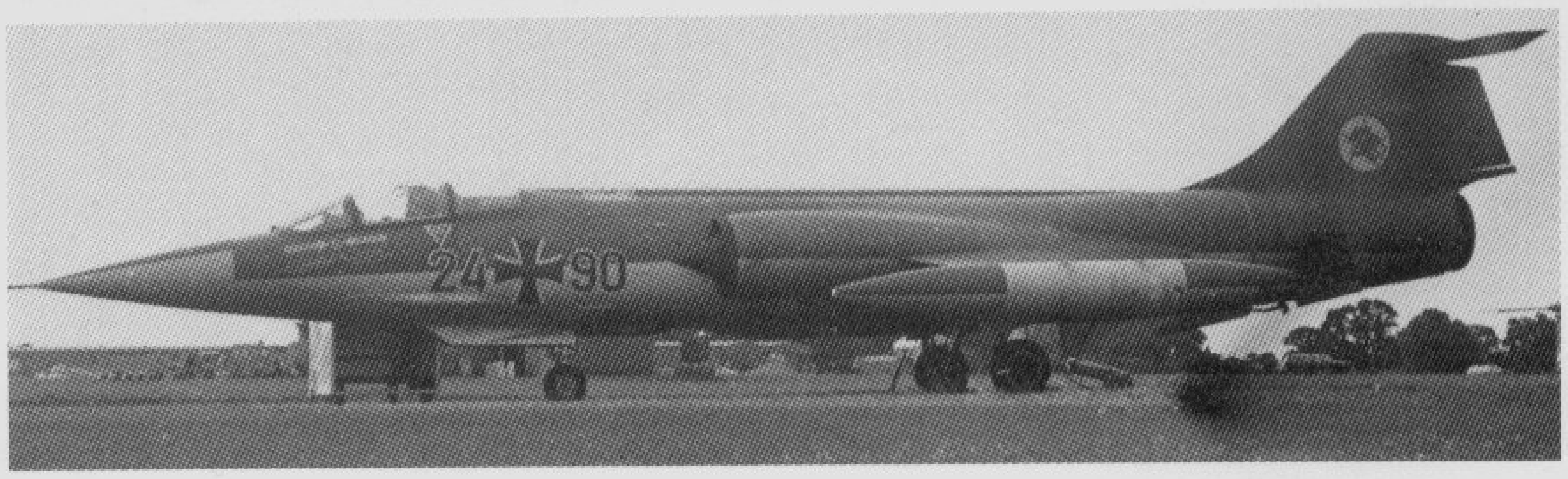
Silver lacquer has been applied to most of the external surfaces of this F-104G of the Norwegian Air Force. (MAP)

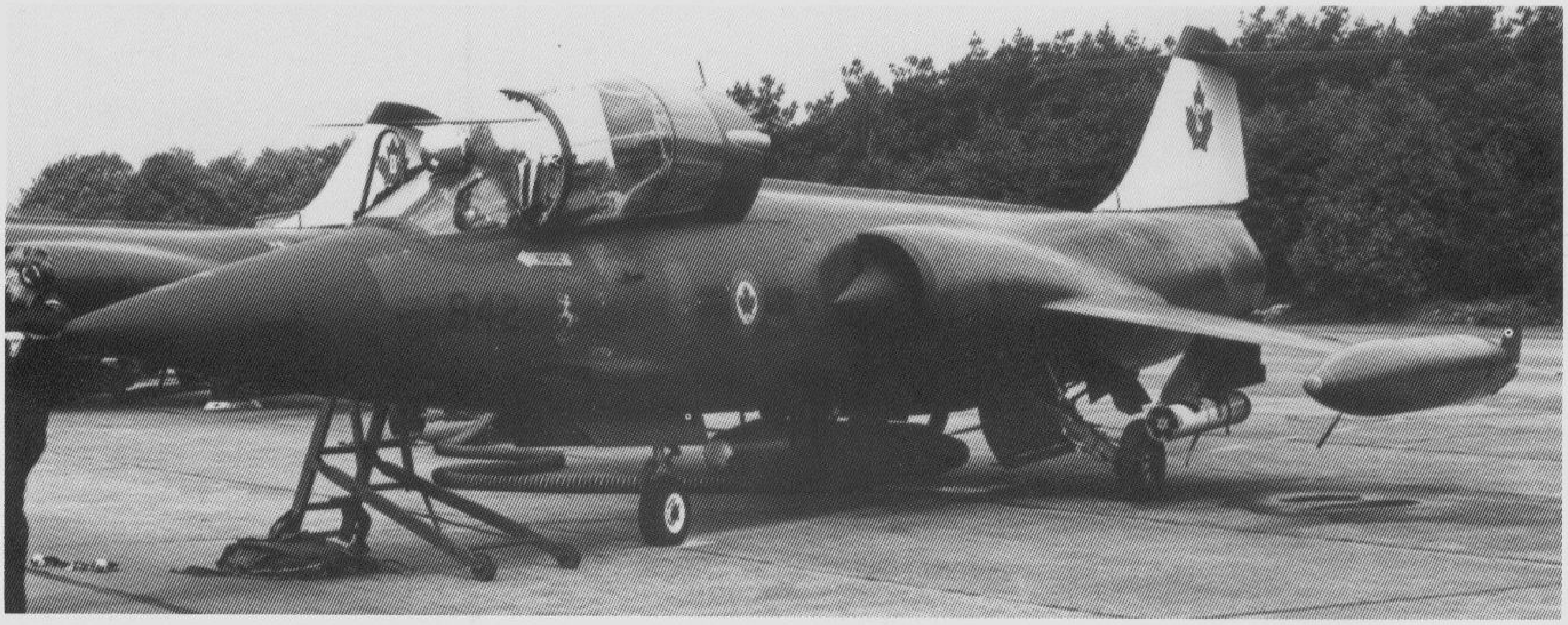




This TF-104G illustrates the markings of the Belgian Air Force. (MAP)

The RF-104G was the reconnaissance version of the F-104G. The cannon was removed, and the cameras were placed in the lower fuselage. A small fairing that extended onto the nose gear doors was added to accommodate the cameras. (MAP)





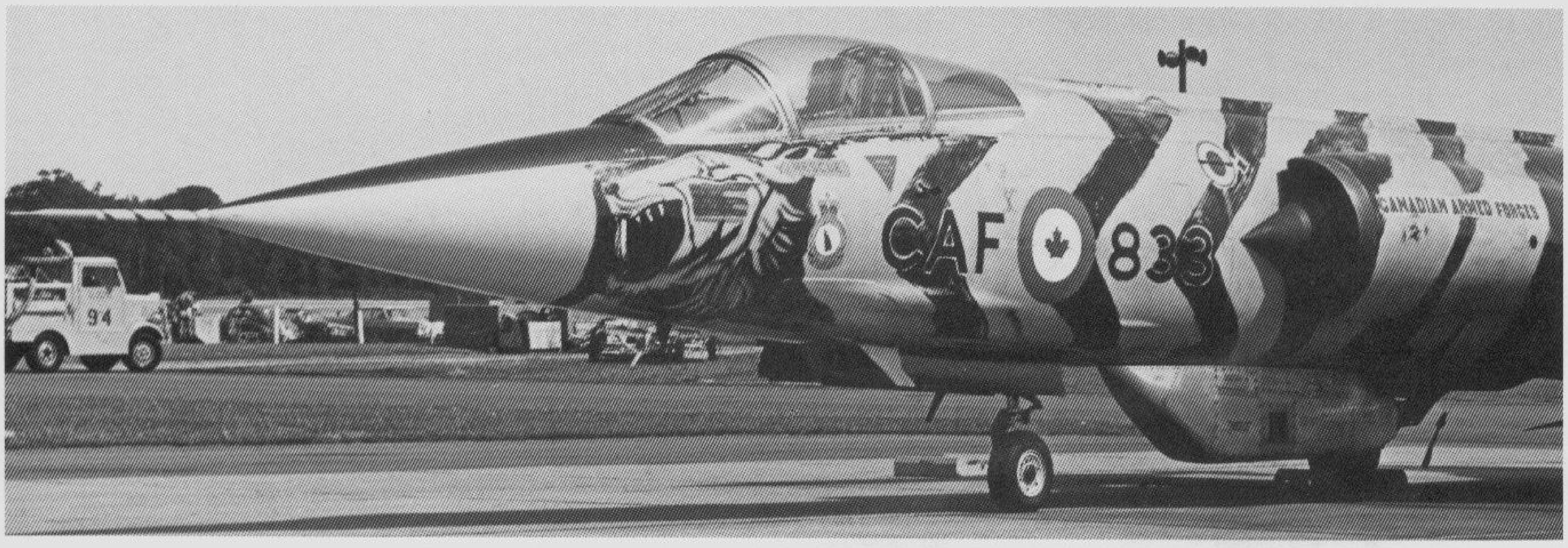
Canadair produced the CF-104 that was used by the R.C.A.F. and the F-104Gs that were supplied to Denmark, Greece, Norway, Spain, and Turkey. Originally, the Canadian Starfighters were designated the CF-111 for the single-seat version and CF-113 for the two-seat variant. But these designations were short lived, and were replaced with the CF-104 and CF-104D designations. This CF-104 of the Number 1 Canadian Air Division (1 CAG) in Europe is painted in an overall olive green scheme. The vertical tail is white with a red maple leaf and a white C. A practice bomb dispenser is on the centerline pylon, and an LAU-5002 A/A 2.75-inch rocket launcher is on the wing pylon. This rocket launcher was for training purposes, and it would not have been used in actual combat. ***(MAP)***

were identifiable by a small fairing under the forward fuselage that extended onto the aft end of the nose landing gear doors. The three cameras were situated to provide vertical, left, and right oblique coverage.

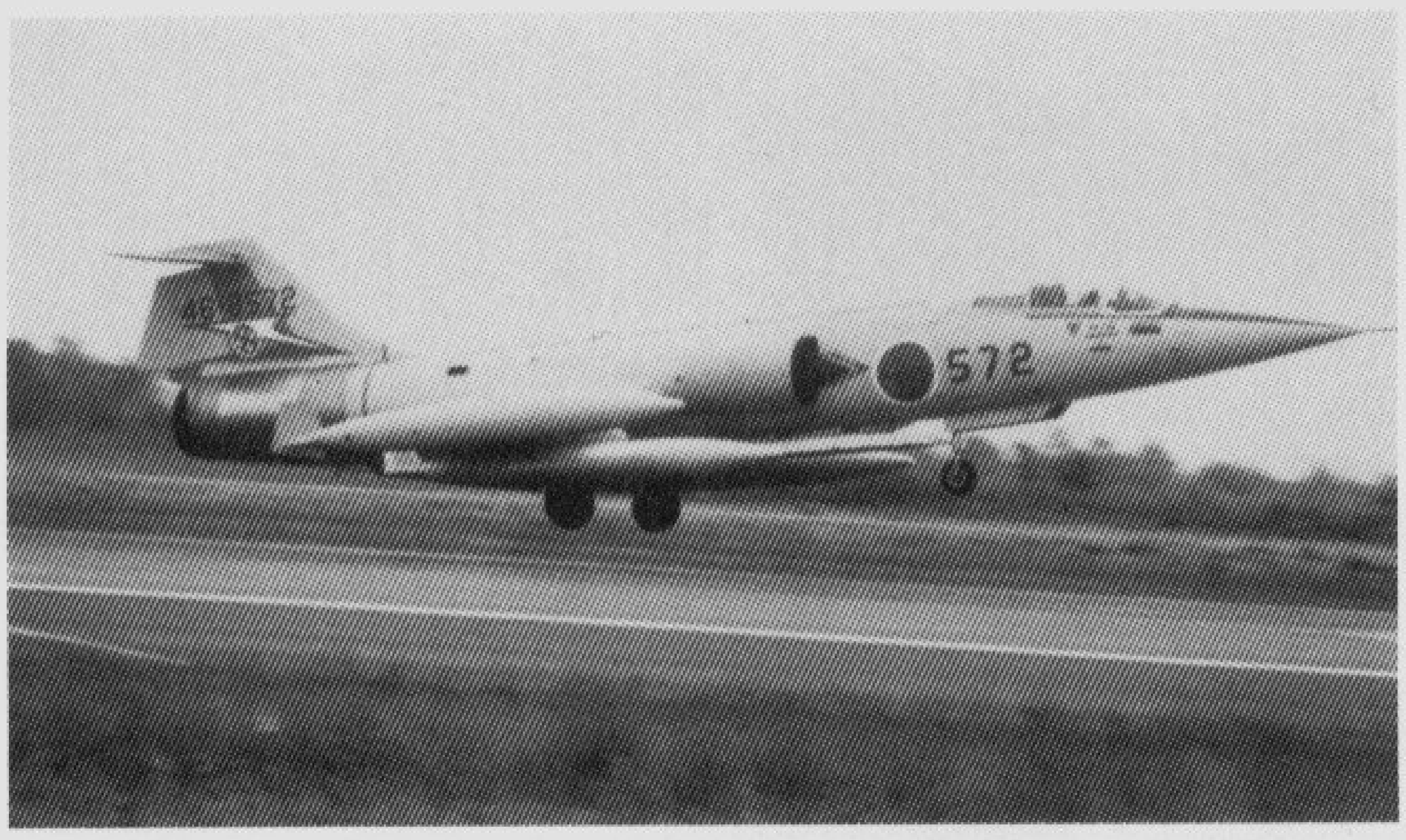
The Canadian Starfighters were similar to the F-104G, and were originally designated CF-111 and CF-113 for the single and two-seat versions respectively. However, this was later changed to CF-104 and CF-104D. The first CF-104 was actually a rebuilt F-104A, 56-770, which served as the prototype. The first true production CF-104 first flew on May 26, 1961.

Originally, CF-104s were not armed with the Vulcan

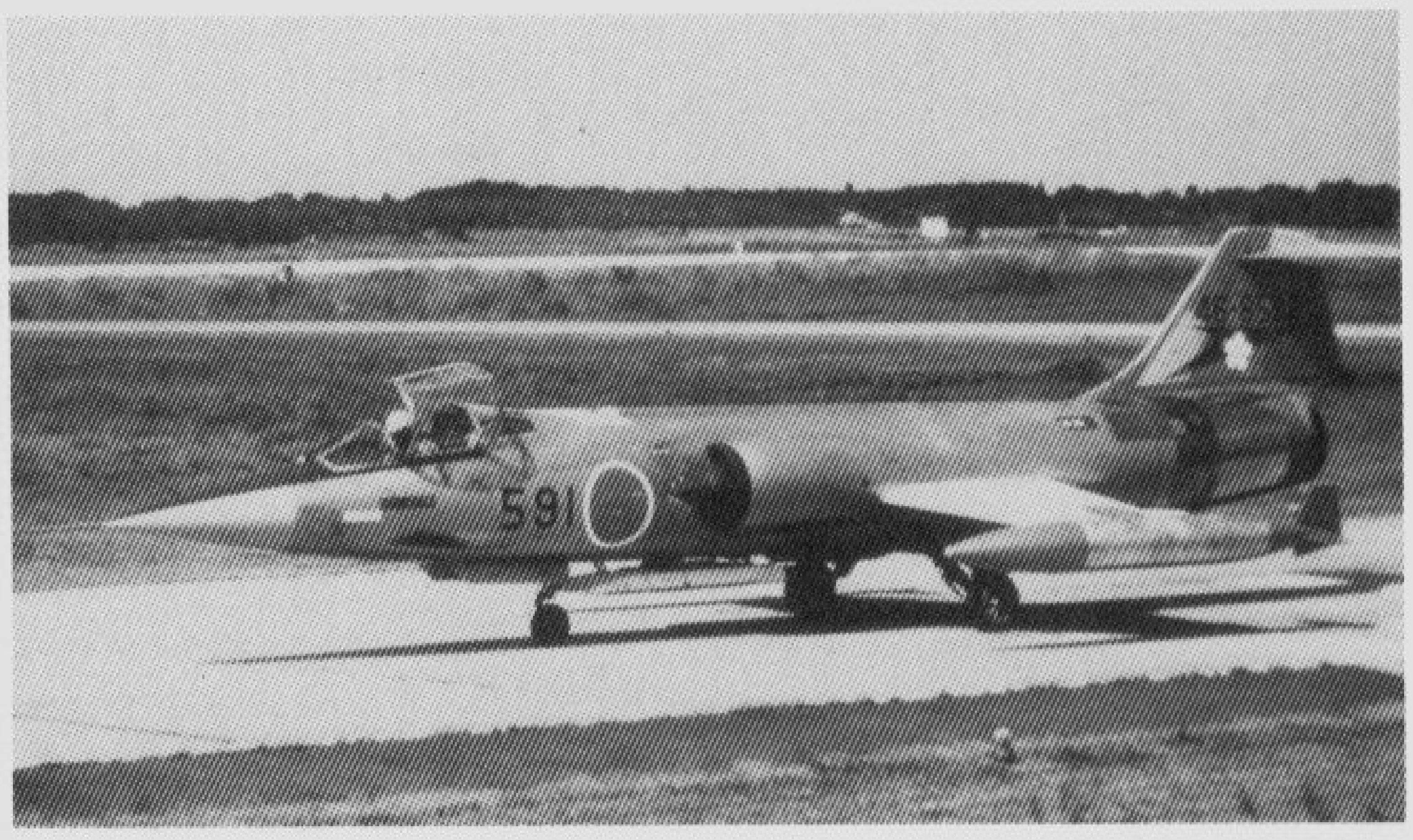
Canada also operated the two-seat version of the Starfighter in the form of the CF-104D. ***(Flightleader)***



For reconnaissance purposes, the RCAF attached a VICON camera pod under the fuselage of their Starfighters. ***(Haynes)***



***Four external fuel tanks are attached to the wing tips and underwing pylons of this F-104J from the 207th Squadron of the 83rd Air Group. It is painted in gray with white wings and bare metal areas on the aft fuselage.* (Flightleader)**



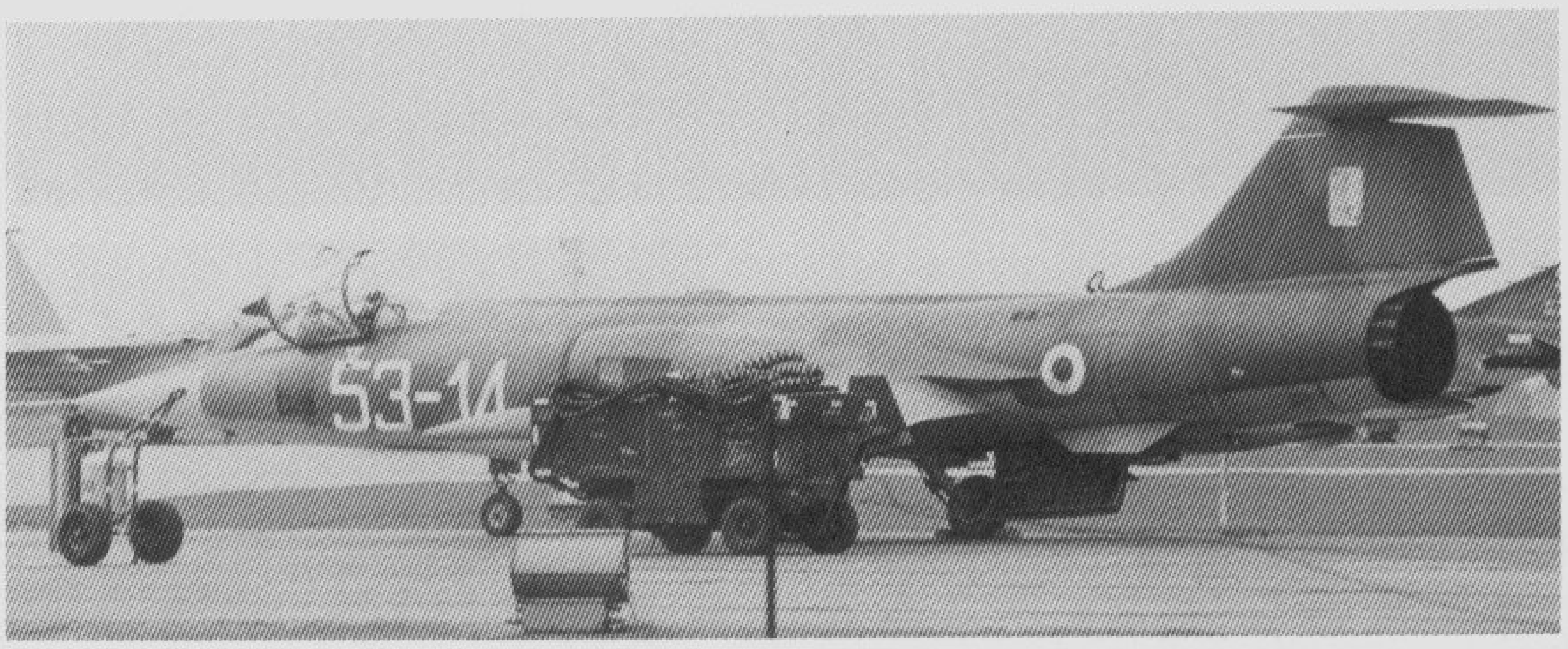
***JASDF Starfighters were often seen with two Sidewinder missile rails under the fuselage as shown here. This arrangement could also be used on most other variants of the Starfighter as well, and this left the wing tips available to carry external fuel tanks.* (Flightleader)**

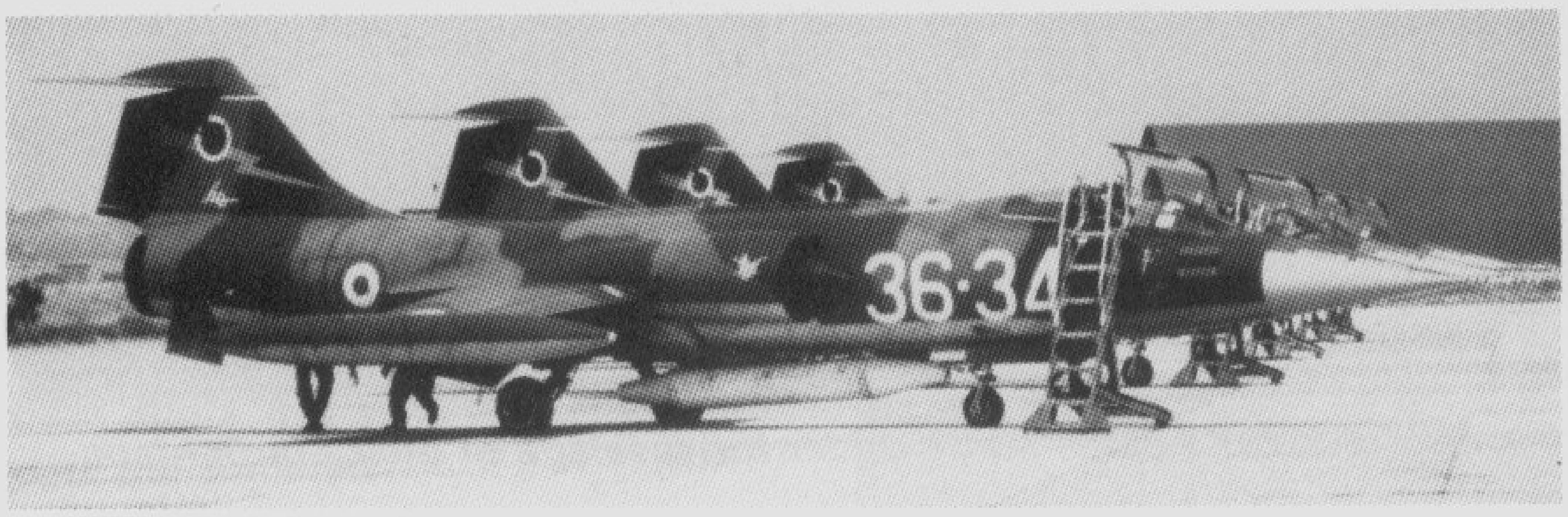
cannon, carrying additional internal fuel instead. But the cannon was added much later in 1974. The CF-104 also used the R-24A NASARR radar which was optimized for the air-to-ground role instead of the version carried by the F-104G that balanced both air-to-air and air-to-ground capabilities. The reason for this change was that Canada intended its CF-104s to be used to deliver nuclear weapons from bases in Europe.

The last foreign production program was in Italy, which produced the F-104S for its own use and for Turkey. With a radar capable of guiding the AIM-7 Sparrow missile, the F-104S had a true all-weather intercept capability. This was the primary role which the Italians intended for this version, but it also retained a secondary ground attack capability. The F-104S was powered by the J79-GE-19 engine which provided 17,900 pounds of thrust in afterburner. The prototype first flew in December 1966, and the first production aircraft made its first flight on December 30, 1968.

Although the Starfighter was produced by a very successful cooperative effort by Lockheed and the companies of several foreign nations, it did have its dark moments. There were accusations and evidence of bribes in getting West Germany to select and produce the aircraft. Many experts contended that the aircraft was too advanced and difficult to fly by Germany's fledgling and inexperienced pilots. The same was true for the pilots of other nations as well. They were being asked to run before they could walk. All nations, including the United States, experienced a very high accident rate with the Starfighter. Even though its performance was outstanding, it was unforgiving of error, and even experienced and very competent pilots managed to prang in the F-104. But it provided a very important part of NATO's defenses for many years, and it is hard to dispute that it played a significant role in helping deter Soviet aggression in Europe.

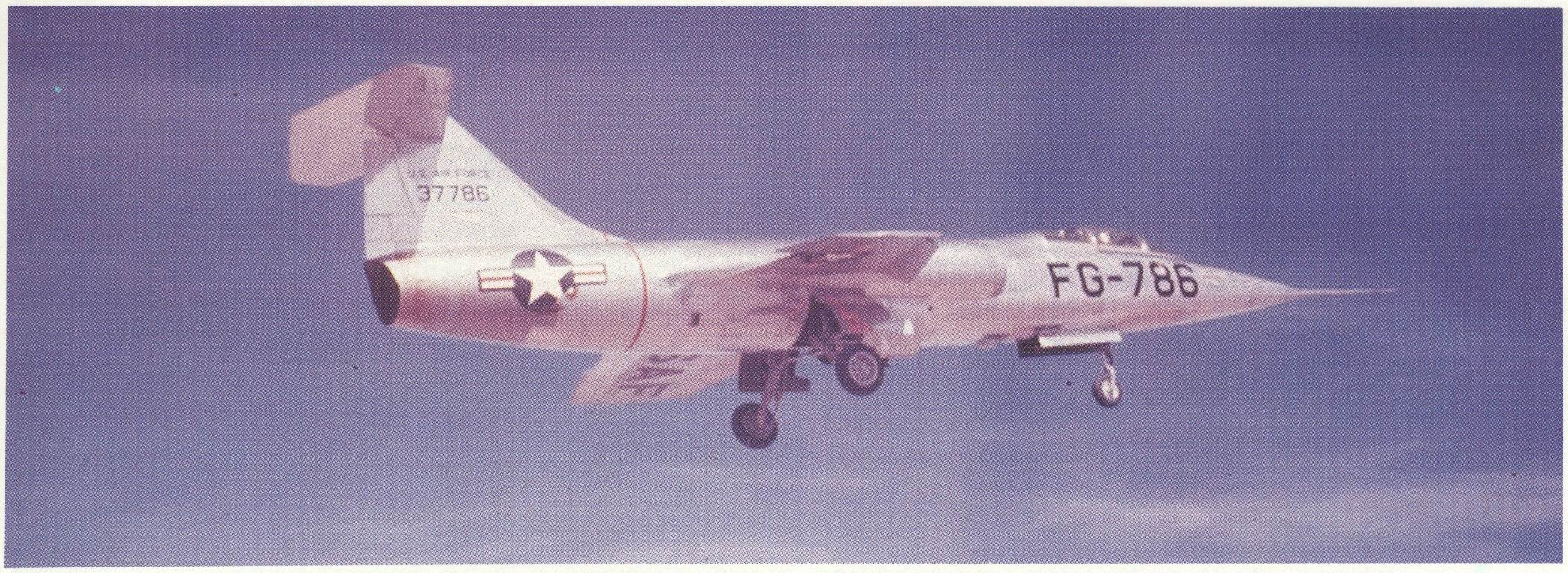
***One of the recognizable features of the F-104S was the addition of small fins on the aft fuselage, very much like those on the F-16. One of these fins is visible in this view, and can be seen just below the national insignia.* (MAP)**



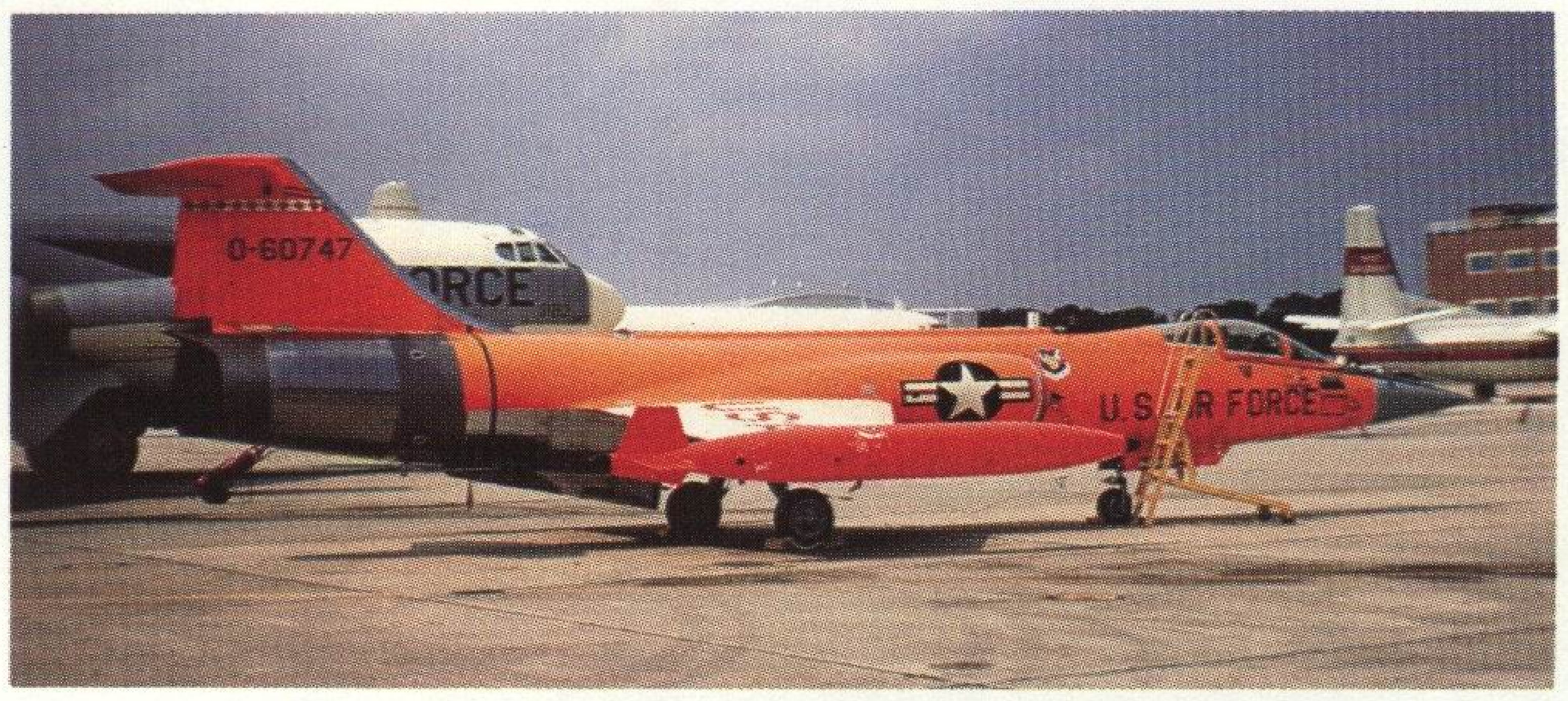


***This F-104S carries a practice bomb dispenser on its centerline station.* (Flightleader)**

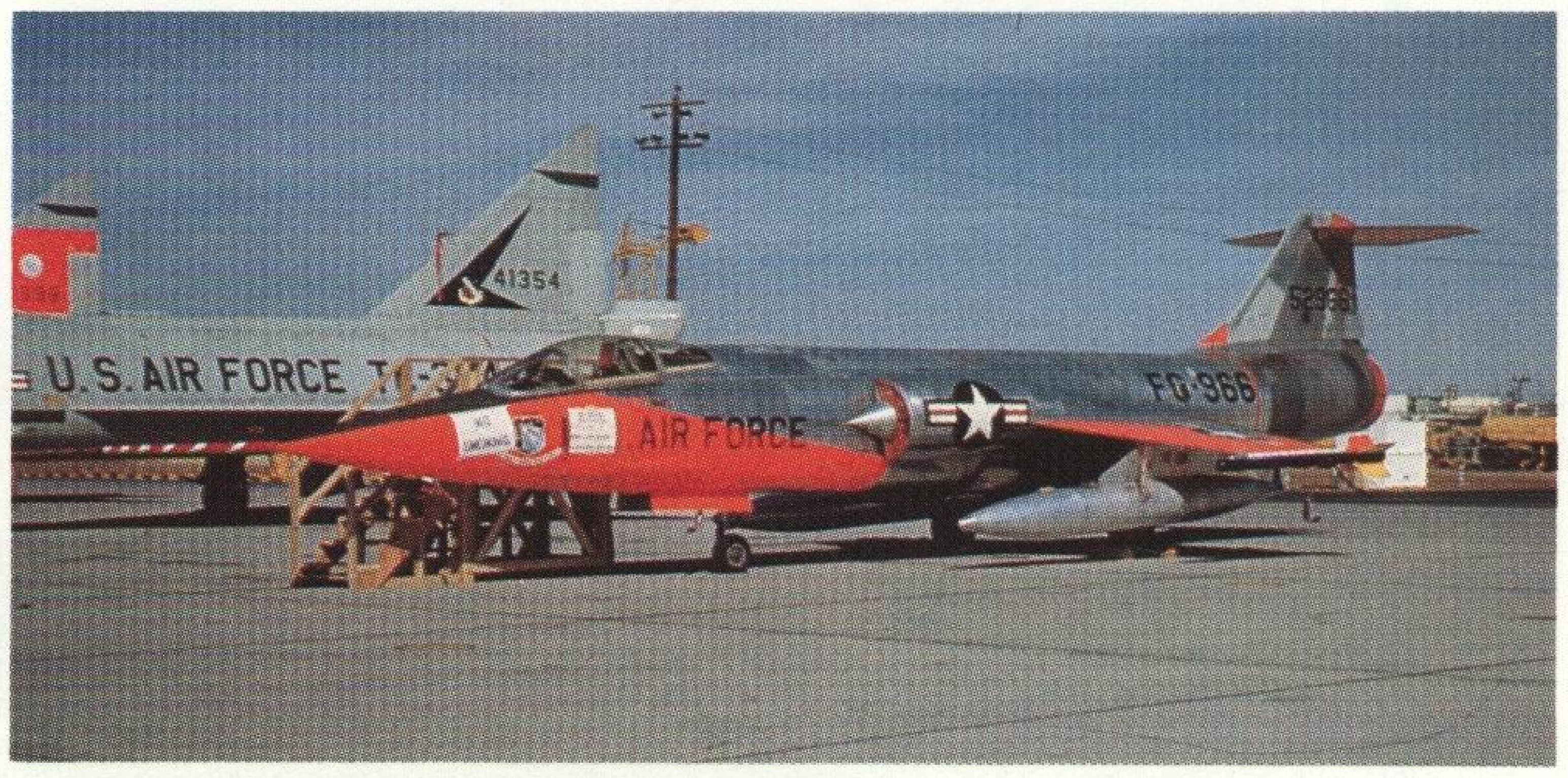
STARFIGHTER COLORS



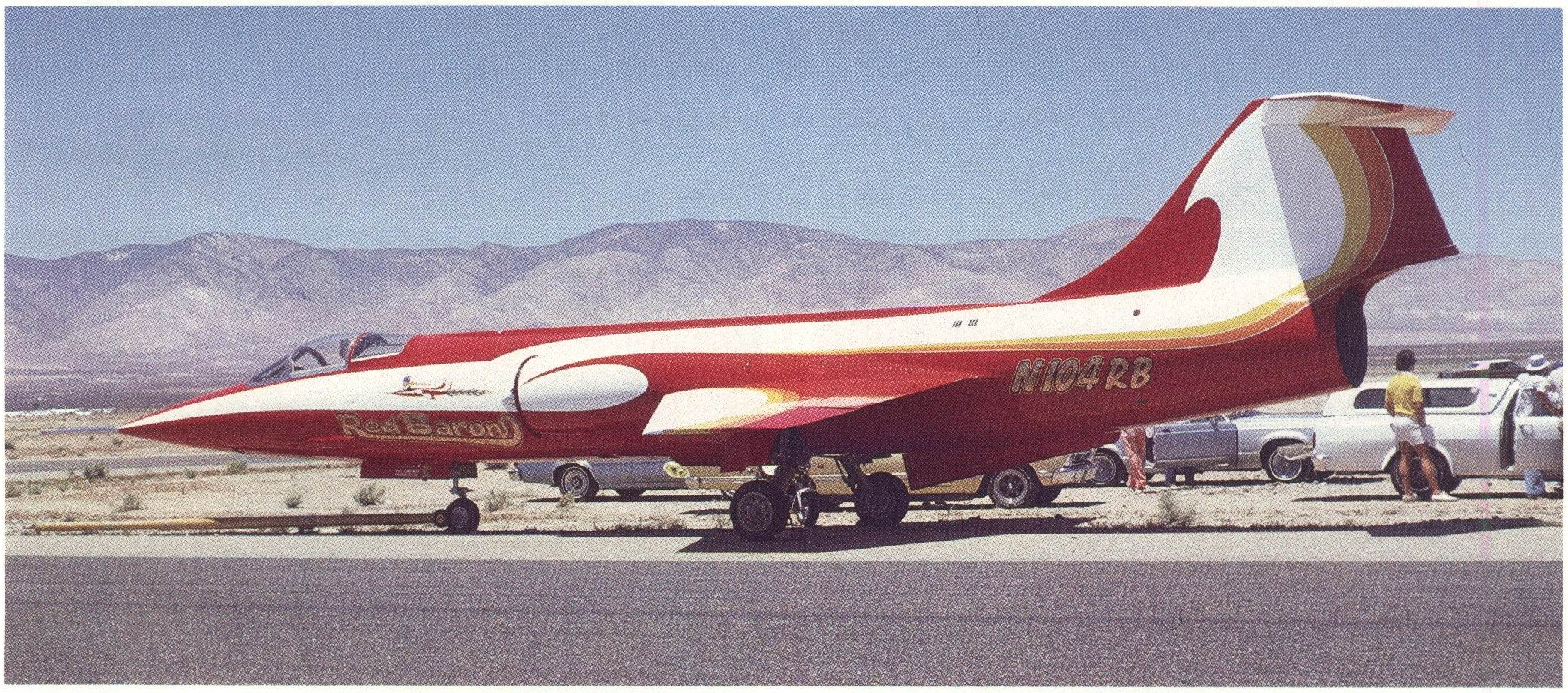
The first XF-104 is shown here in flight with its landing gear lowered. Note that the XF-104 had its nose gear at the front end of the well, meaning that it retracted rearward. The two XF-104s were the only single-seat Starfighters with this arrangement. All other single-seaters had the gear at the aft end of the well. (USAF via Menard)



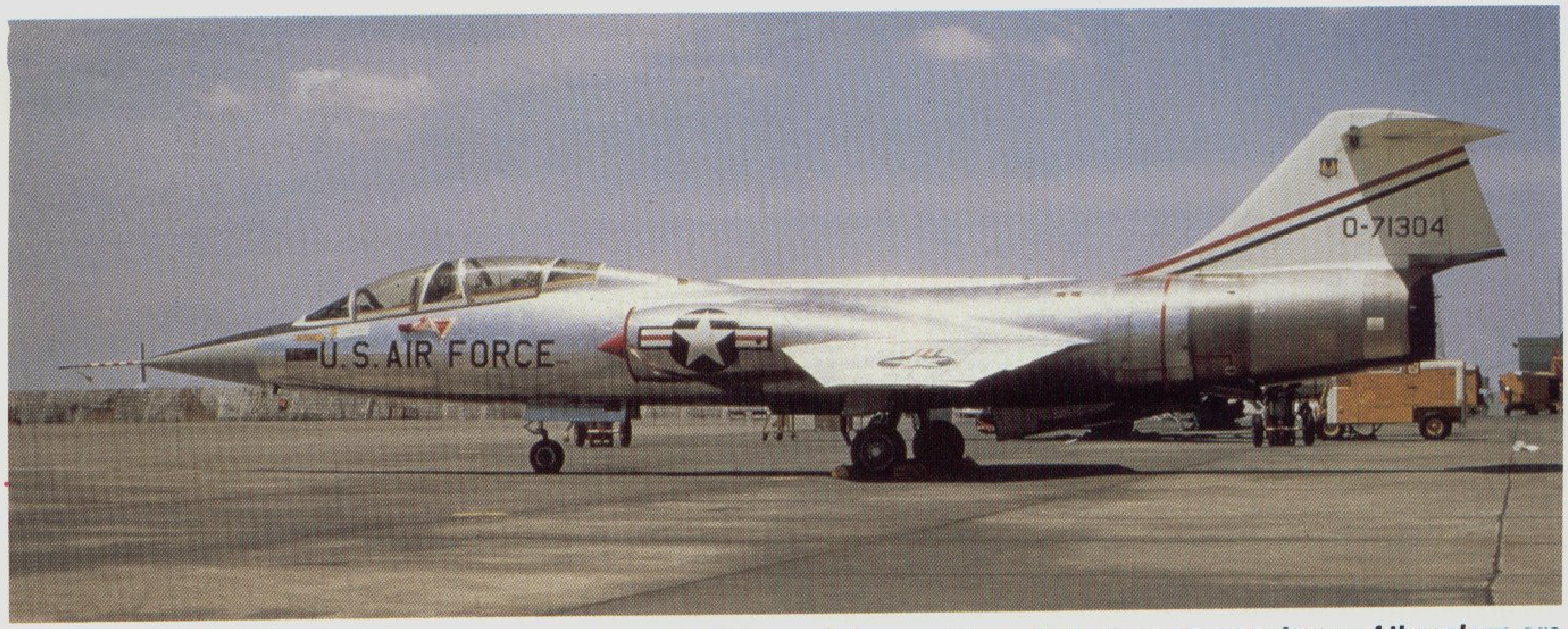
QF-104A drones were painted overall international red-orange with white wings. The nose cone usually remained gray, and the aft fuselage was left bare metal. (Brewer via Menard)



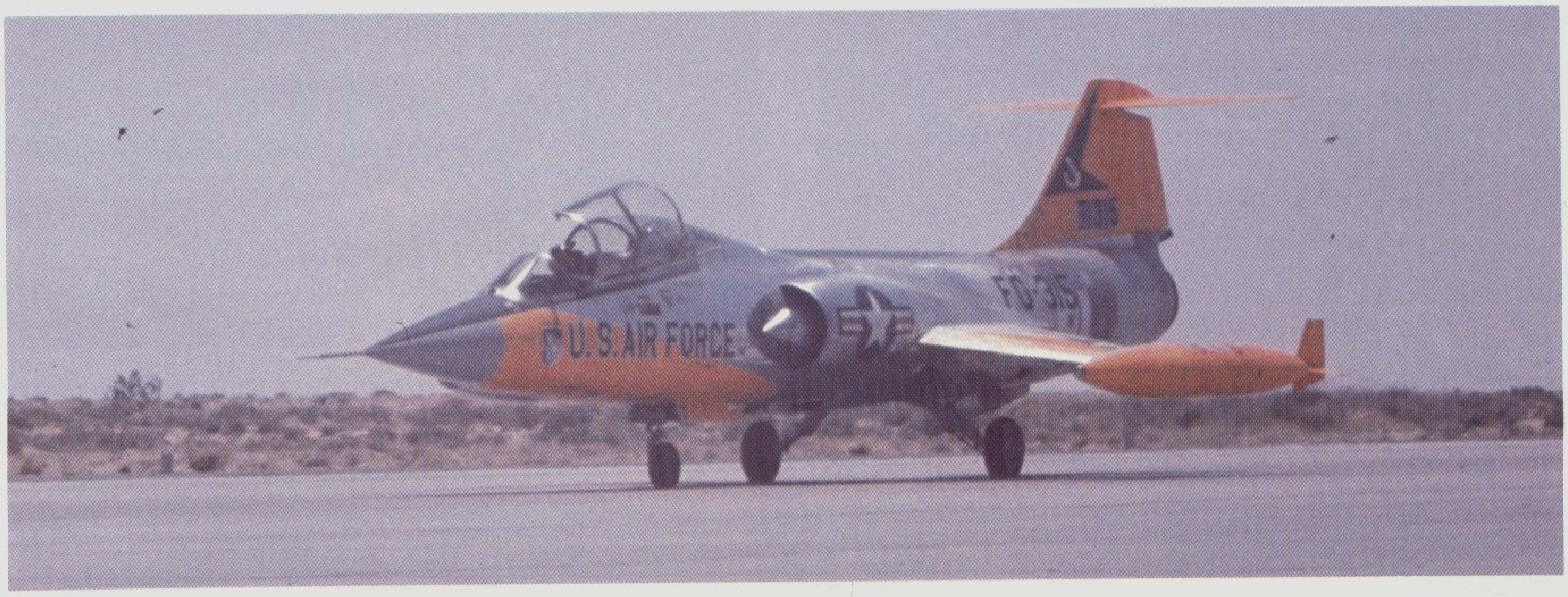
One of the YF-104s is shown here with high visibility markings. Note the unusual colors on the Sidewinder missile. (Picciani Aircraft Slides)



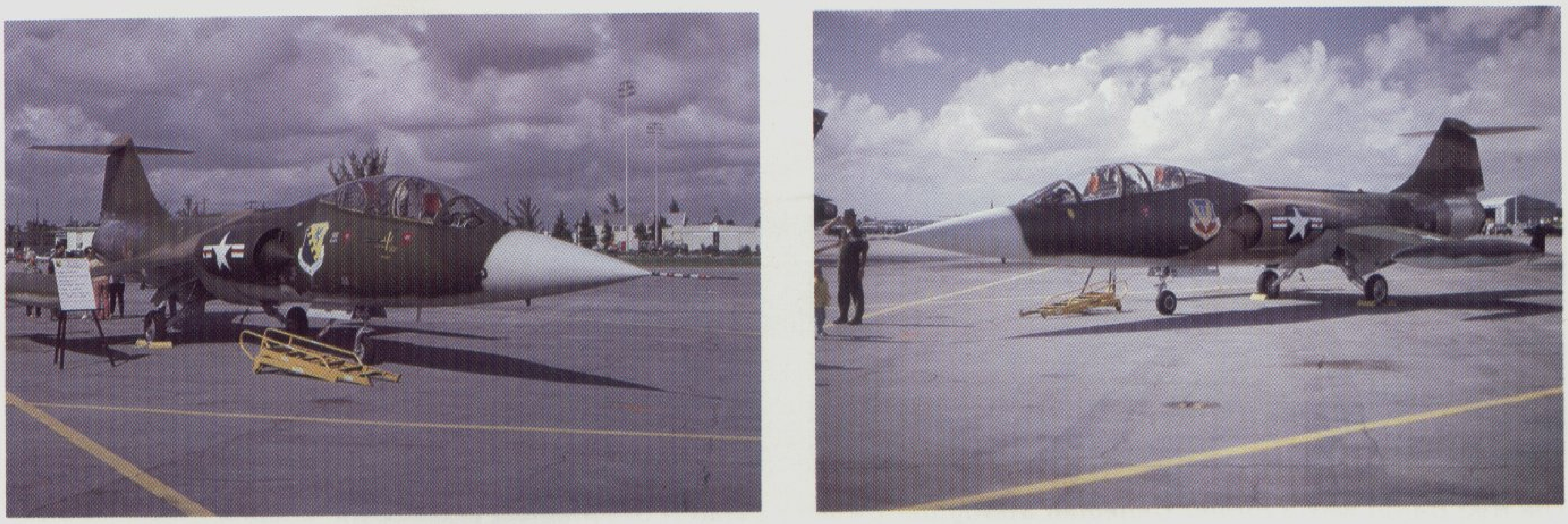
The Red Baron was a former Canadian Starfighter owned by Darryl Greenemyer and used to attempt a world speed record at low altitude. Although the record was set, it was not officially recognized due to a malfunction in the measuring equipment on the ground. The aircraft was destroyed in an accident in February 1978 during a second attempt to establish the record. Nevertheless, this Starfighter is undoubtedly the fastest aircraft ever owned by a civilian. (Brewer via Flightleader)



This bare metal F-104B sports a white tail with red, white, and blue markings. Only the upper surfaces of the wings are white, and the radome is ADC gray. This aircraft was assigned to the Air Force Logistics Center.
(Picciani Aircraft Slides)



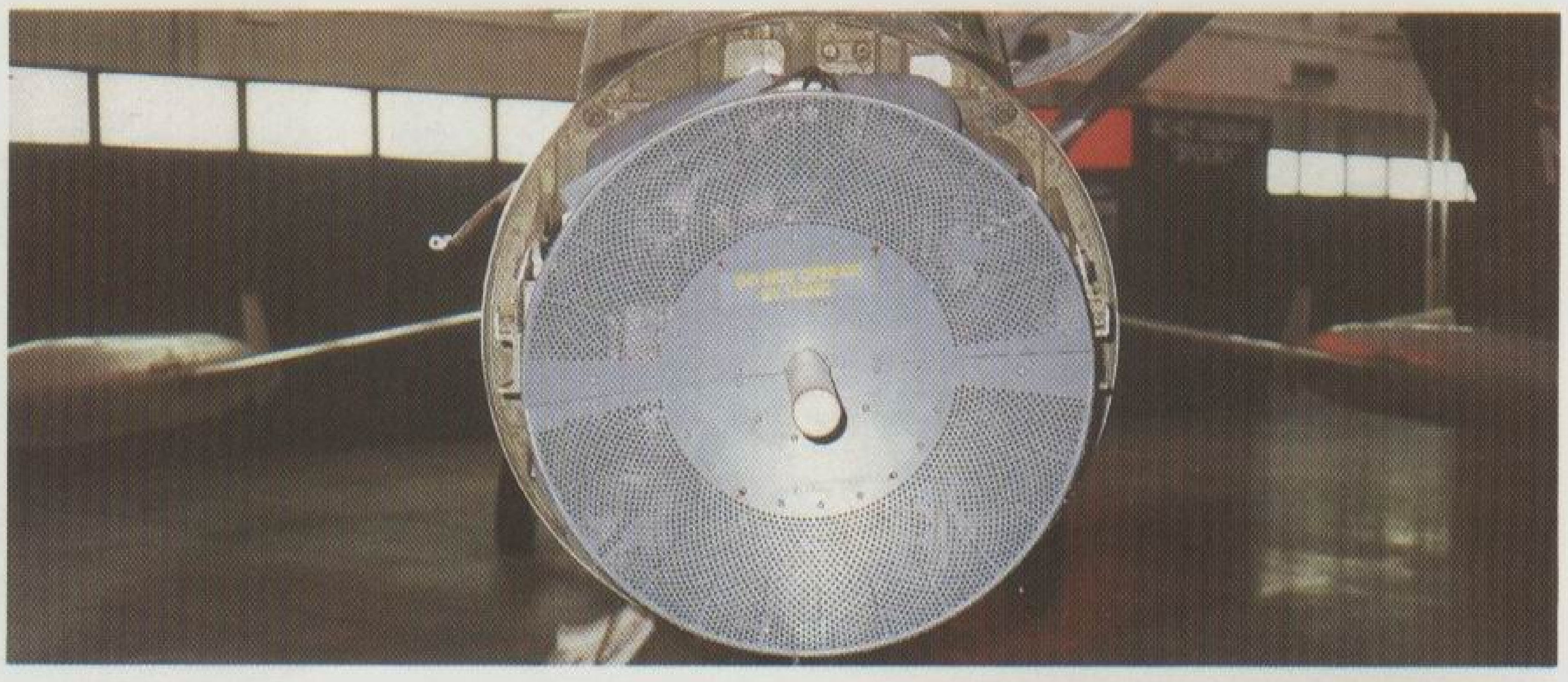
The second F-104D, 57-1315, sports high visibility orange markings and has the early style two-seat canopy.
(Petty via Menard)

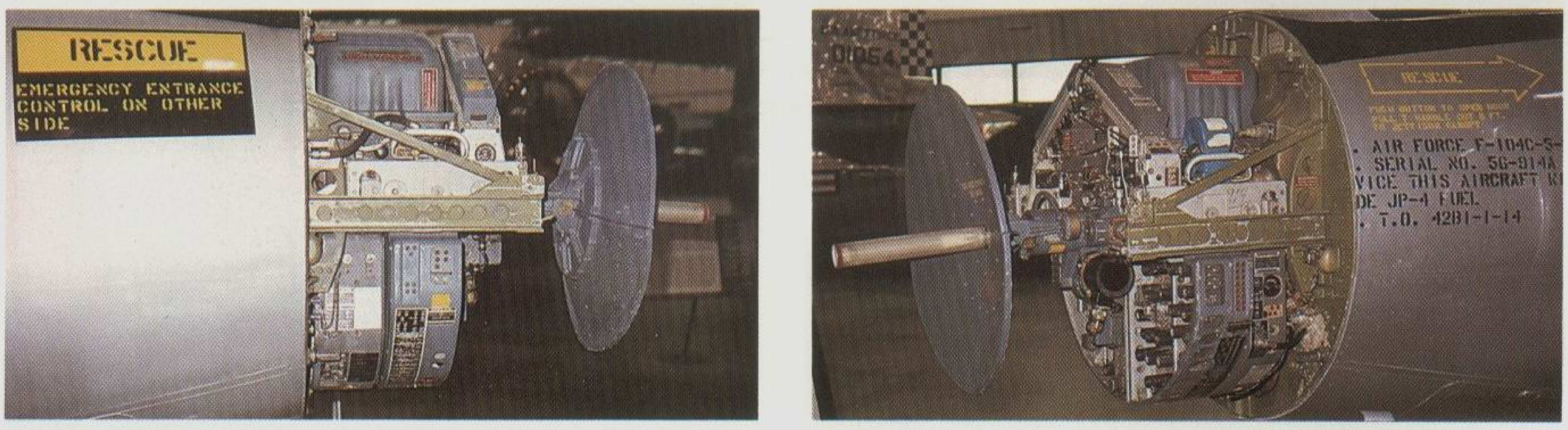


These two views show both sides of F-104B, 57-1305, which was photographed at Homestead AFB, Florida, in November 1971. Homestead AFB is the home of the 31st TFW, and it is this unit's wing insignia that is painted on the right side of this aircraft. The TAC badge is on the left side. However, the 31st TFW never operated the Starfighter, thus making the markings on this aircraft unusual. ***(Both Flightleader collection)***

RADAR COLORS

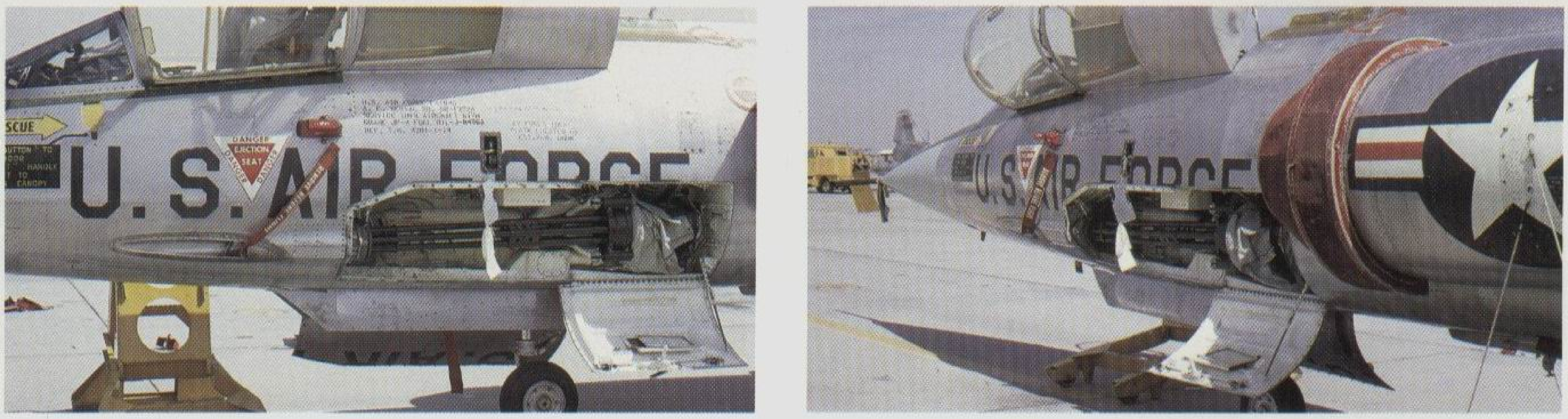
The F-104A and F-104C versions of the Starfighter were equipped with the AN/ASG-14T-1 fire control system. This system included an optical sight, an infrared detector, and the lightweight search radar shown here. On the two-seat F-104B and -D variants, the optical sight was deleted since no gun was installed, however, the IR detector and the radar were fitted. This front view shows the antenna of the search radar to good effect.



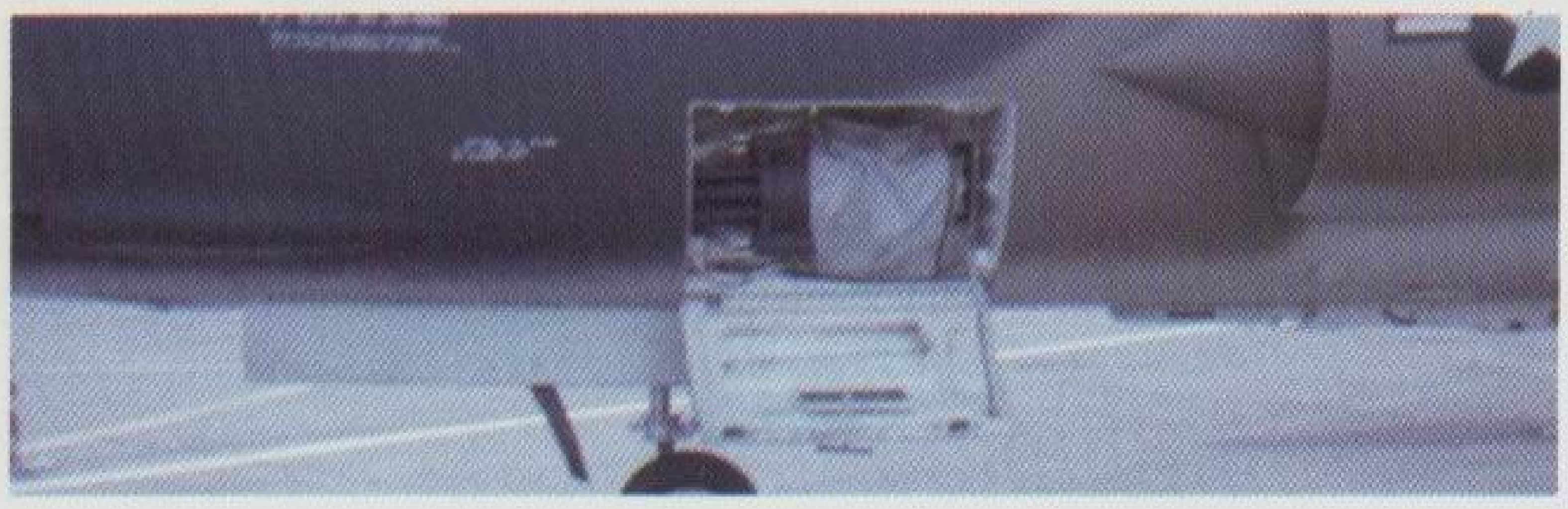


These right and left side views show details and colors of the radar.

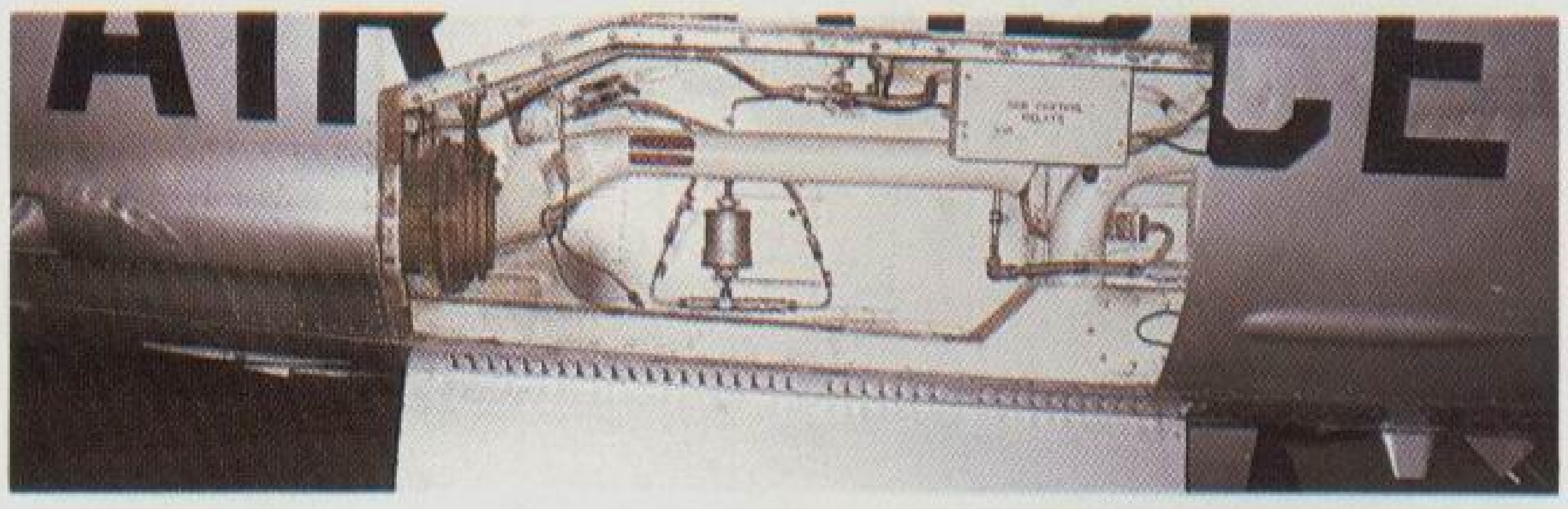
20MM VULCAN CANNON



From the beginning, single-seat versions of the F-104 were designed to carry the General Electric 20mm Vulcan cannon. However, problems with the gun system's development prevented its installation in initial F-104As. Once these problems were solved, the gun was retrofitted to those aircraft still in service, and was installed in subsequent production single-seat variants. It was not installed in the two-seat variants. These two views show details and colors of the gun from different angles. It should be noted that a hinged door covered the aft portion of the gun's compartment, while the larger forward portion was covered by a removable panel that was not hinged. *(Both Flightleader)*

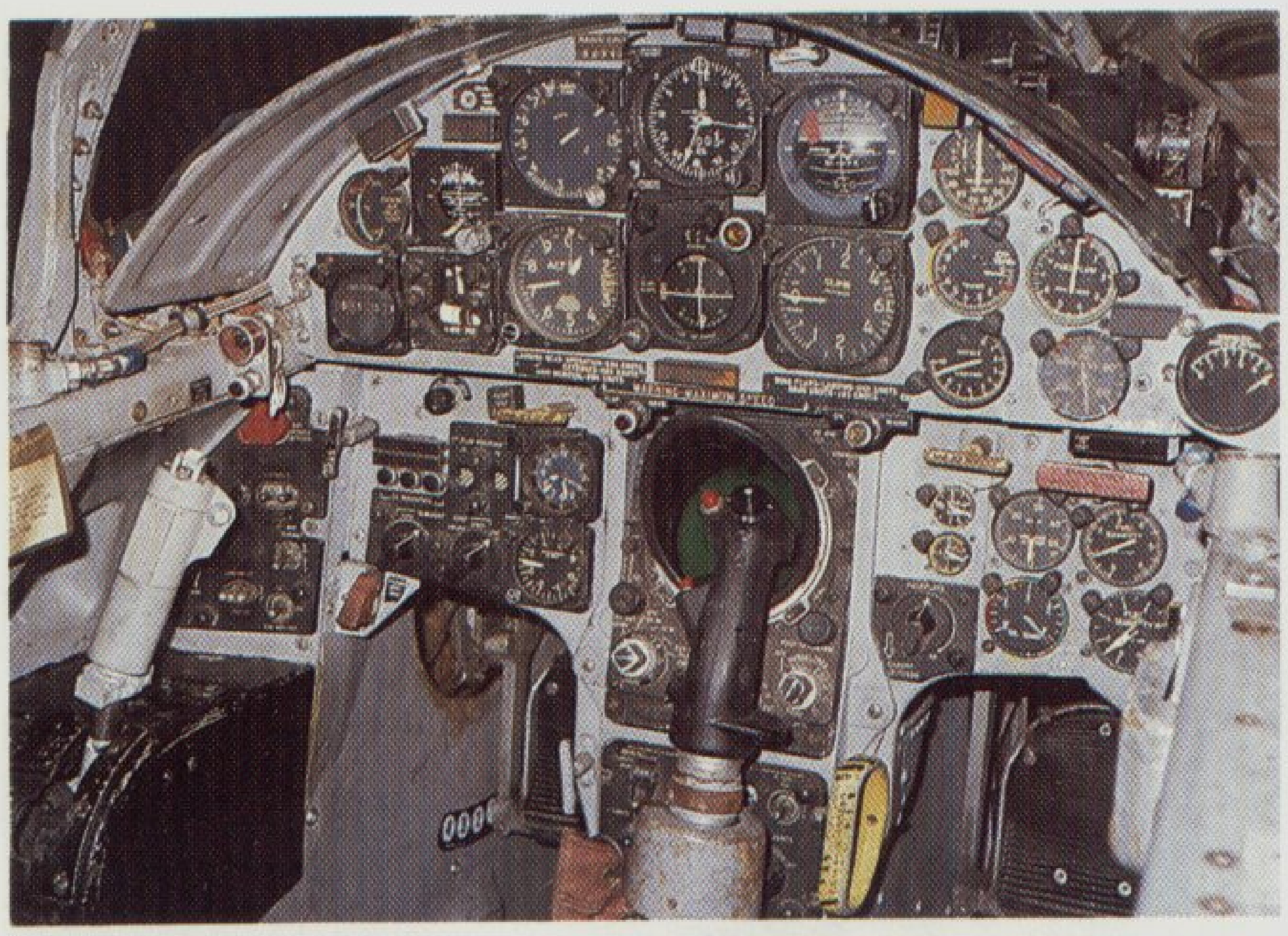


Easy access to the gun was provided by the hinged door, and aircraft were often seen parked with this door open as shown here. The forward panel was not removed unless more extensive maintenance was required.

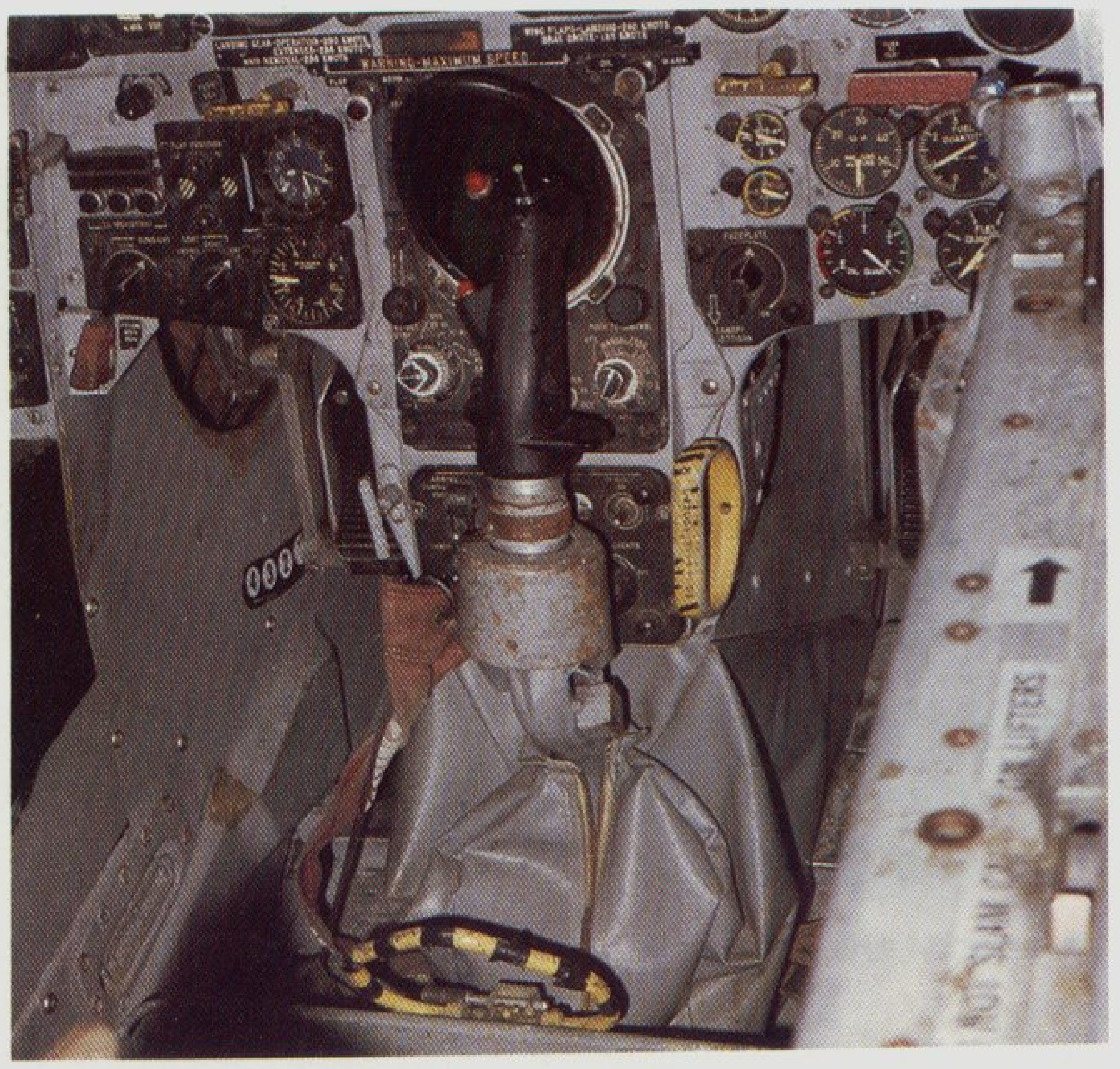


This photograph shows the gun bay with the forward panel and gun removed. Details of the compartment itself are better illustrated without the gun in place. The aft hinged door is closed. Note the small fairing on this door.

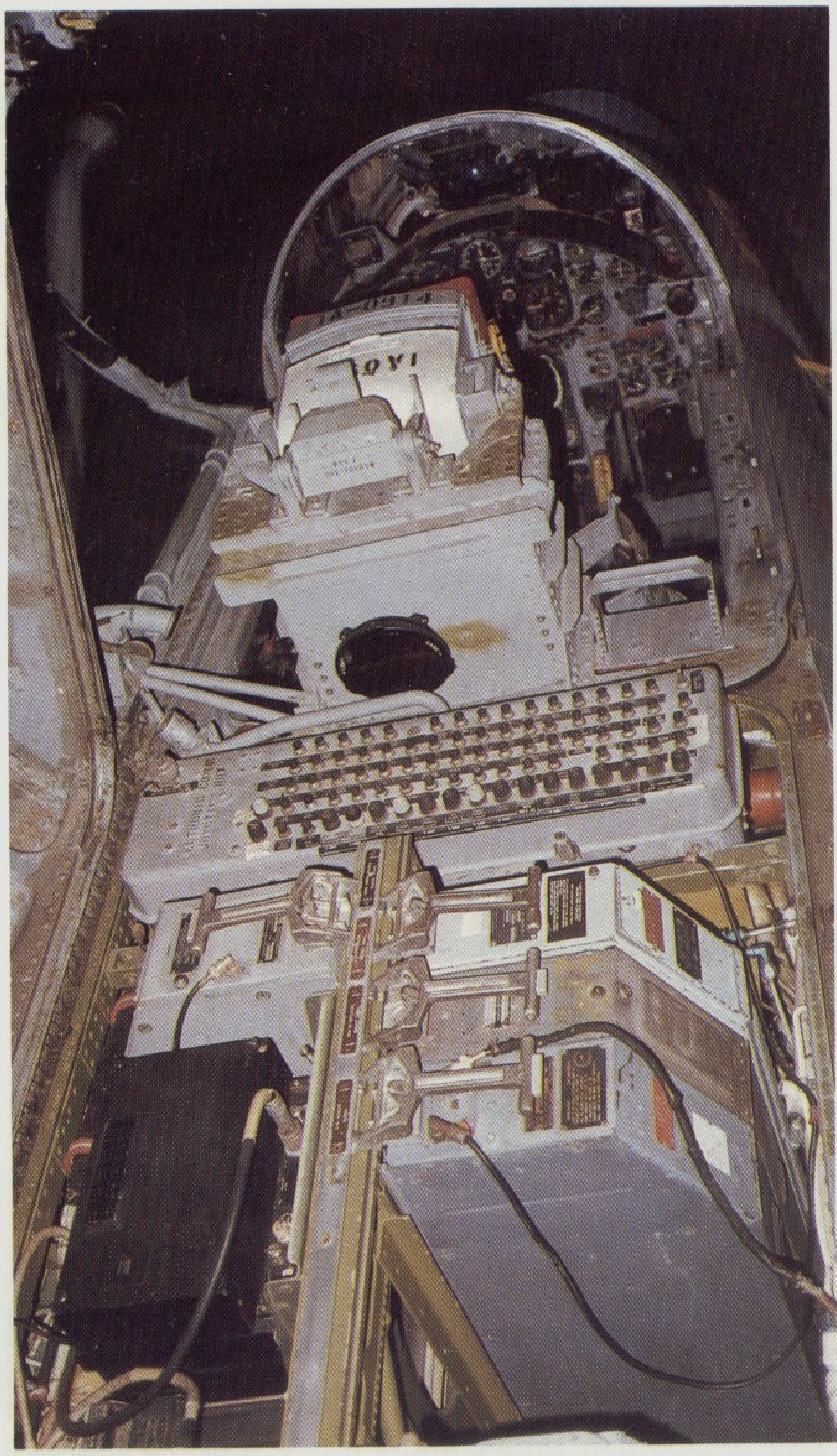
F-104C COCKPIT



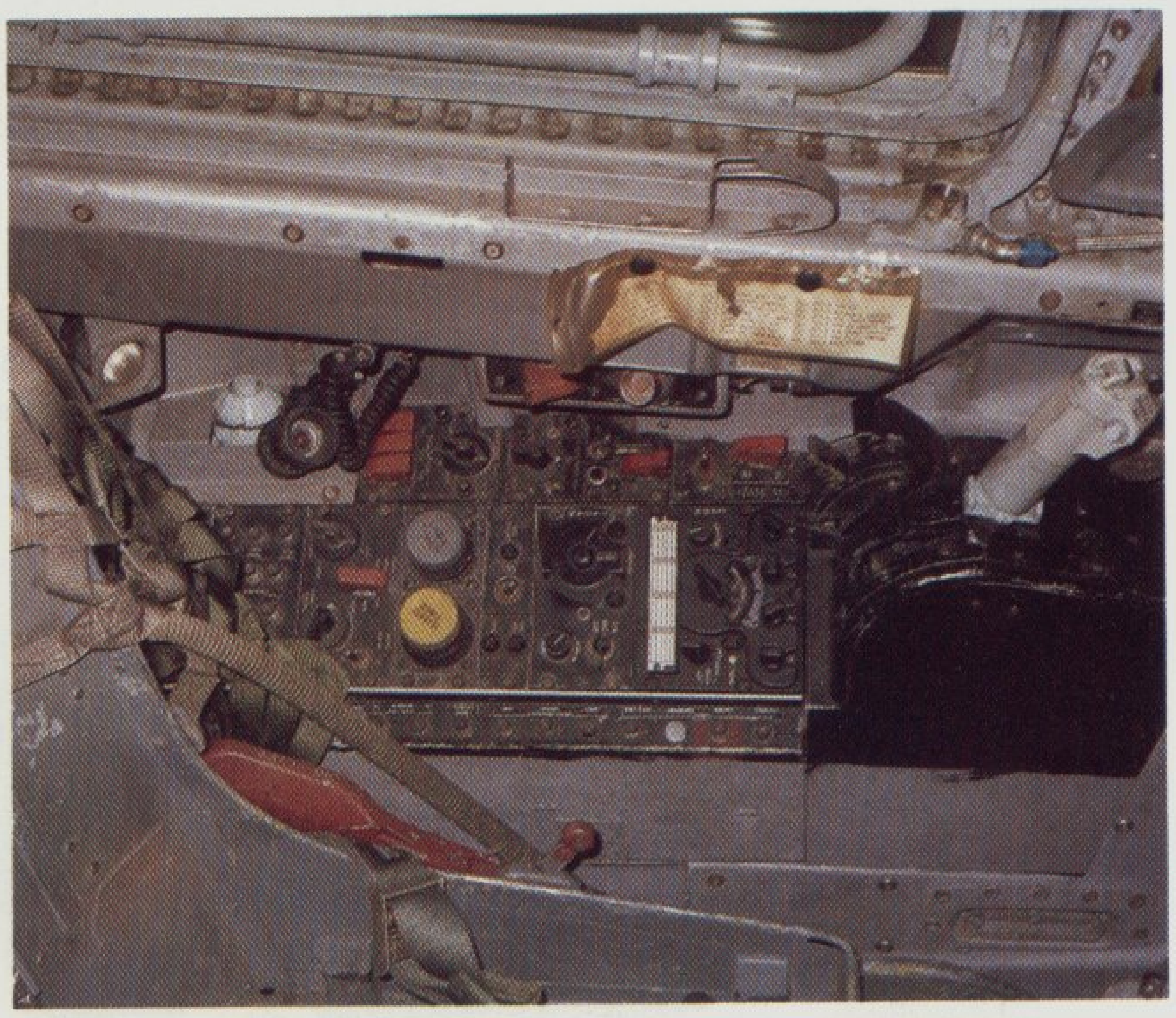
Details of the main instrument panel in an F-104C are illustrated here.



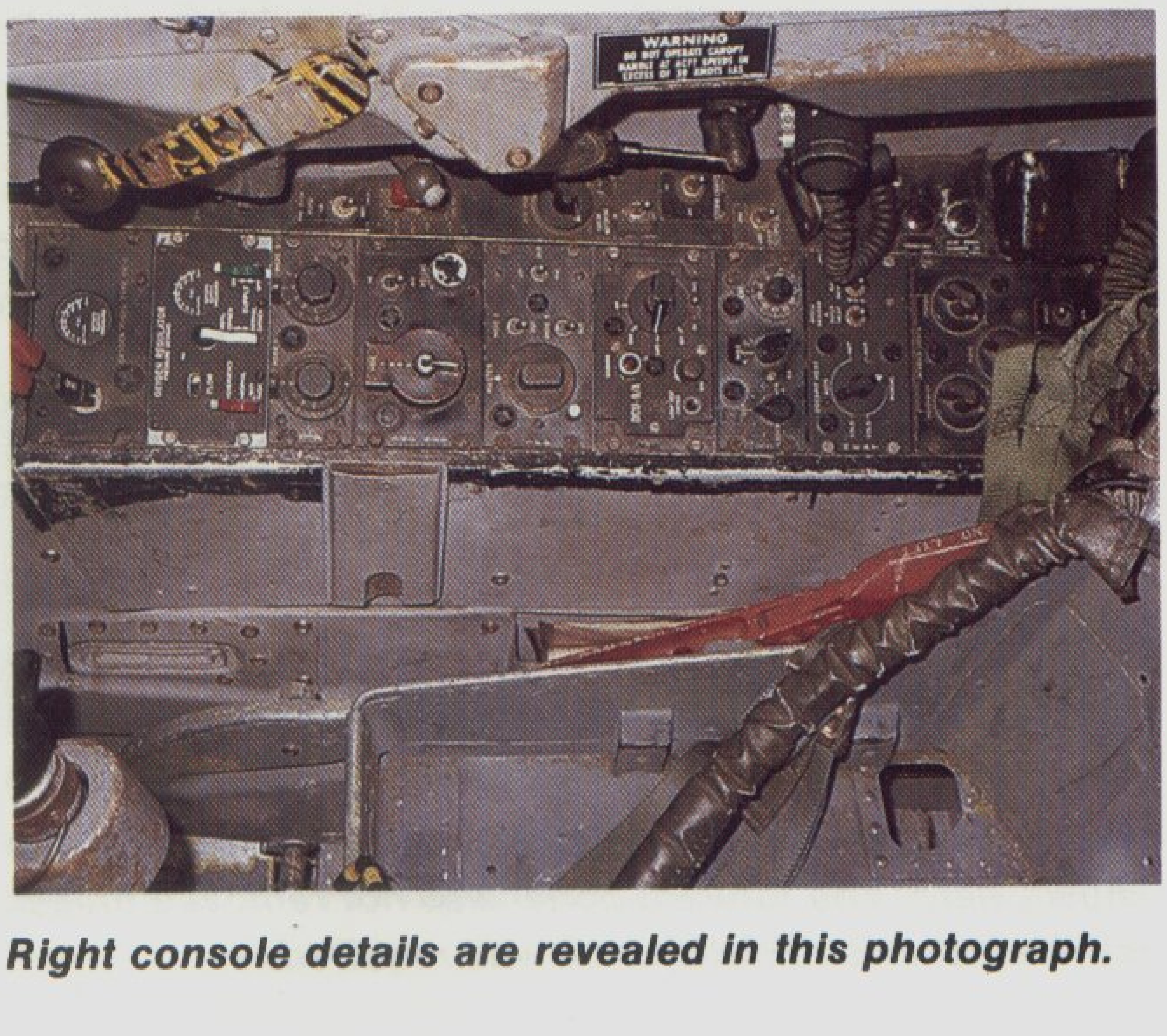
This is the control column and grip.



This view was taken from behind the cockpit and shows the forward end of the avionics bay behind the cockpit and the back of the ejection seat.

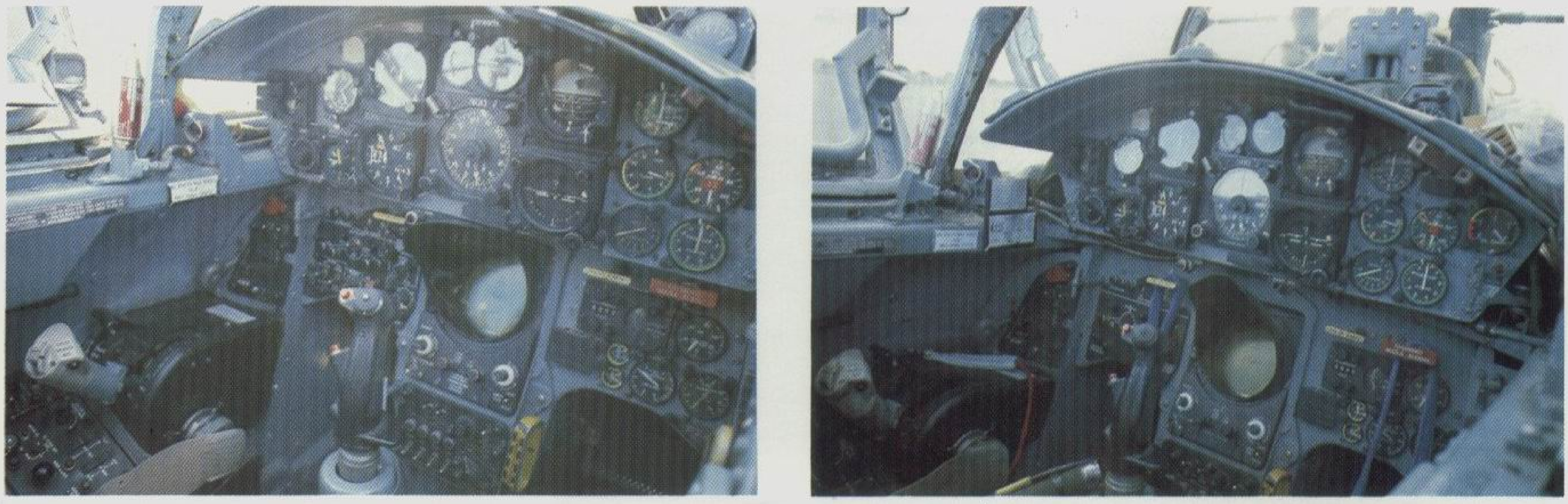


The left console and throttle quadrant are shown here.

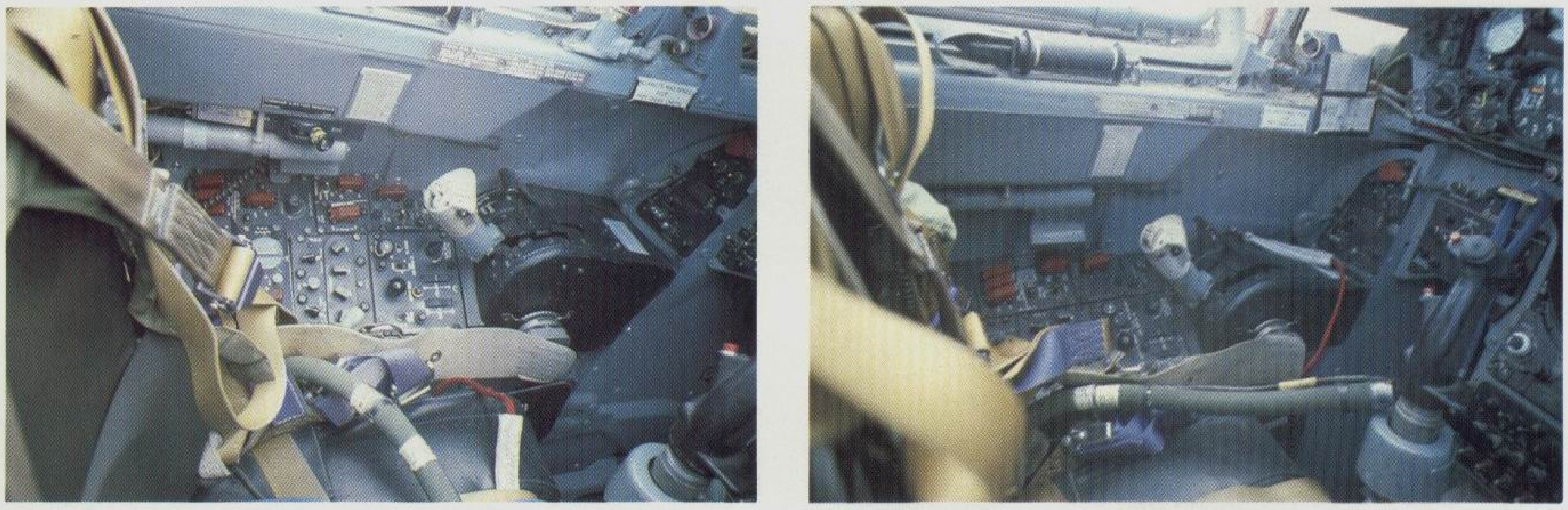


Right console details are revealed in this photograph.

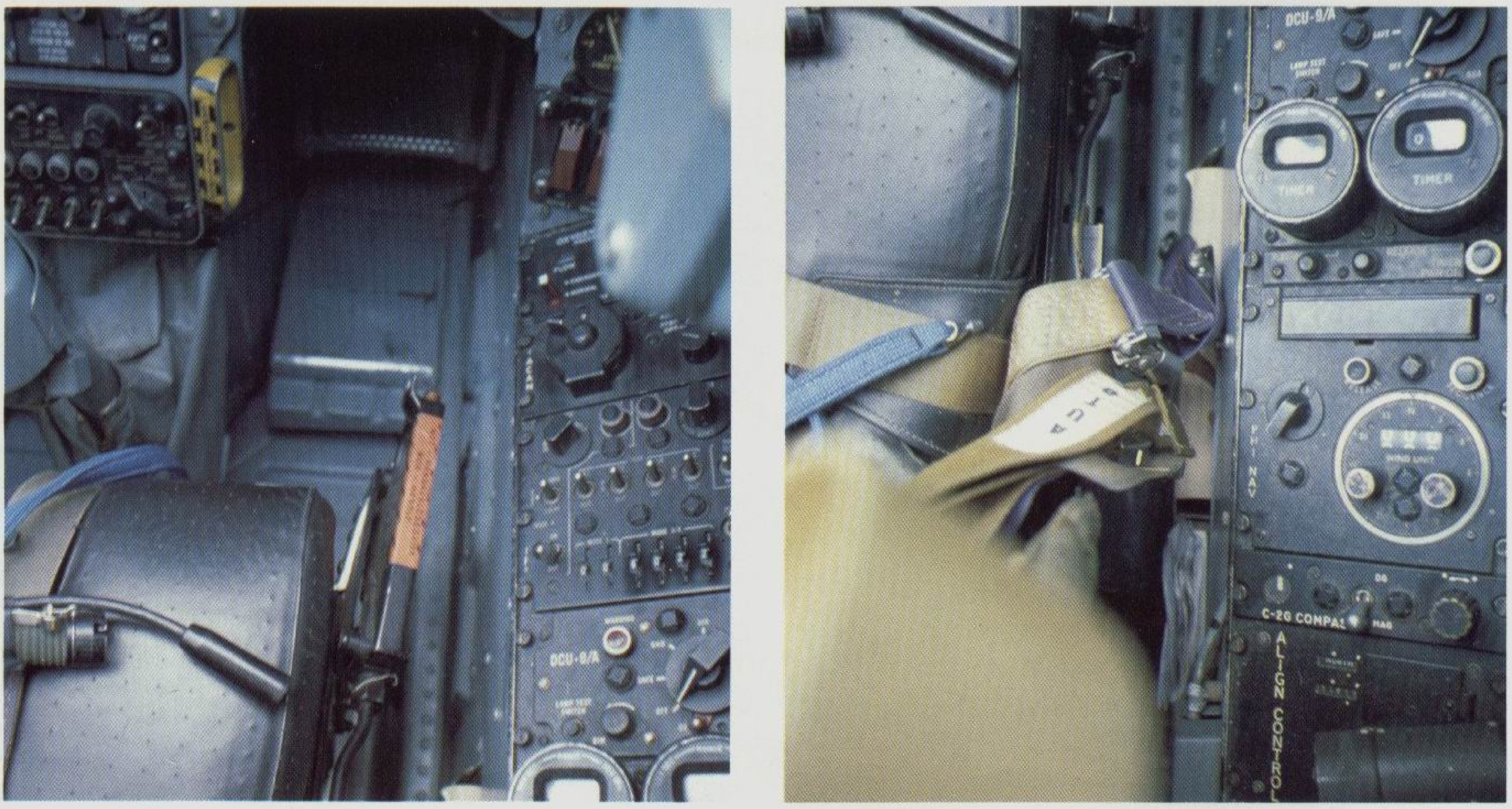
TF-104G COCKPIT



Typical details and colors of the cockpits used in two-seat variants of the Starfighter are illustrated in the photographs on this page. They were taken in a TF-104G. At left is the forward instrument panel, and at right is the instrument panel in the aft cockpit.

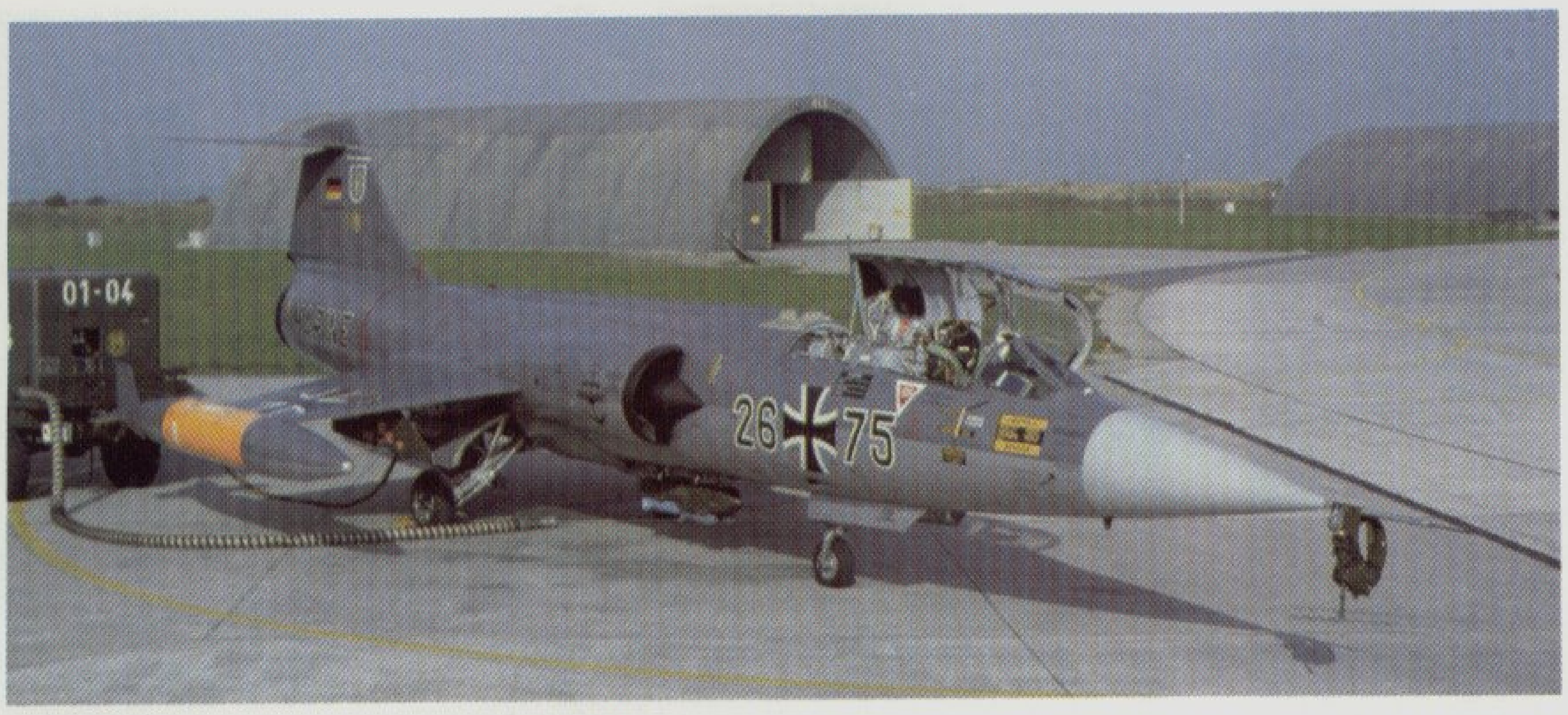


The left console and throttle in the forward cockpit are shown in the photo at left, while at right is a look at the left console and throttle in the aft cockpit.

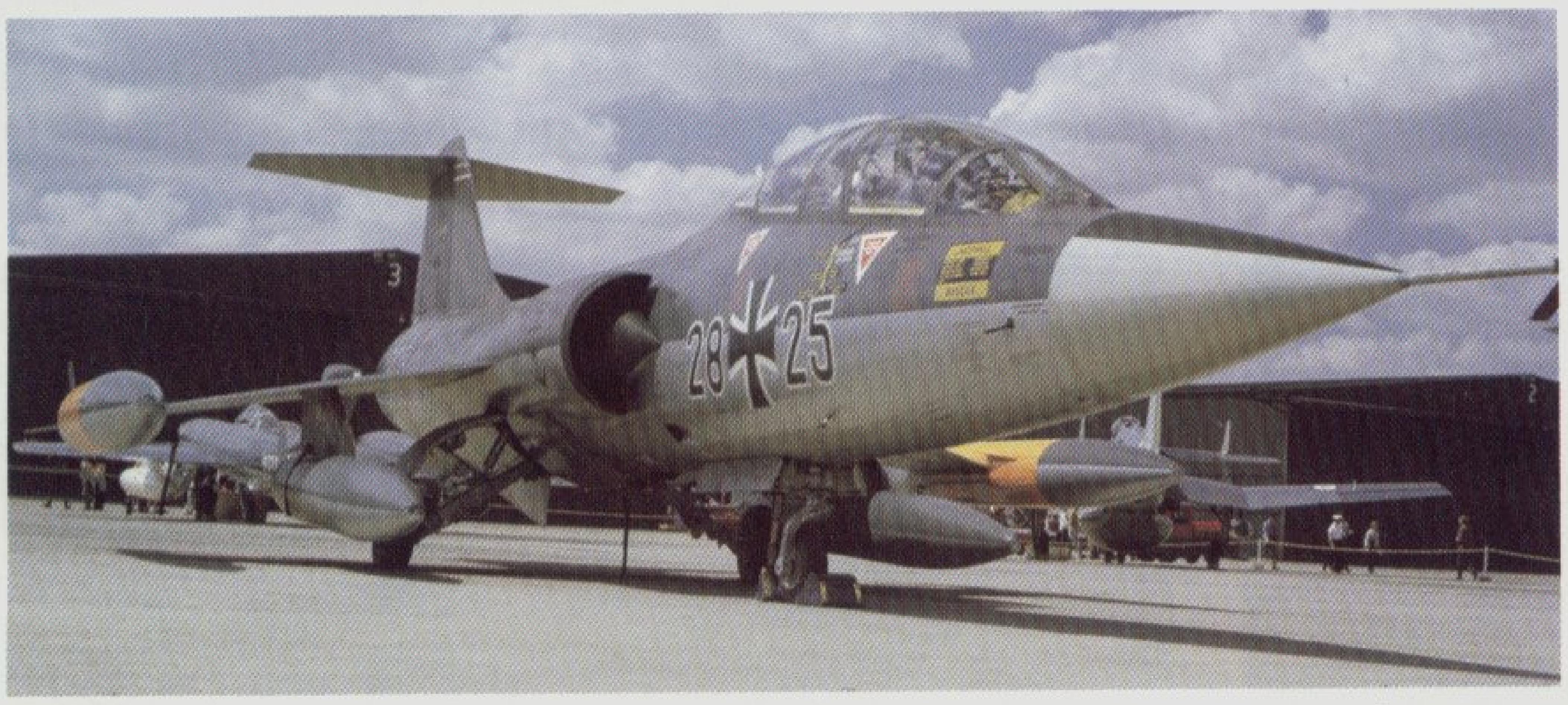


These two views show details of the right console in the front cockpit. The view at left shows mostly the forward end of the console, while the photo at right is a close-up of the rear of the console.

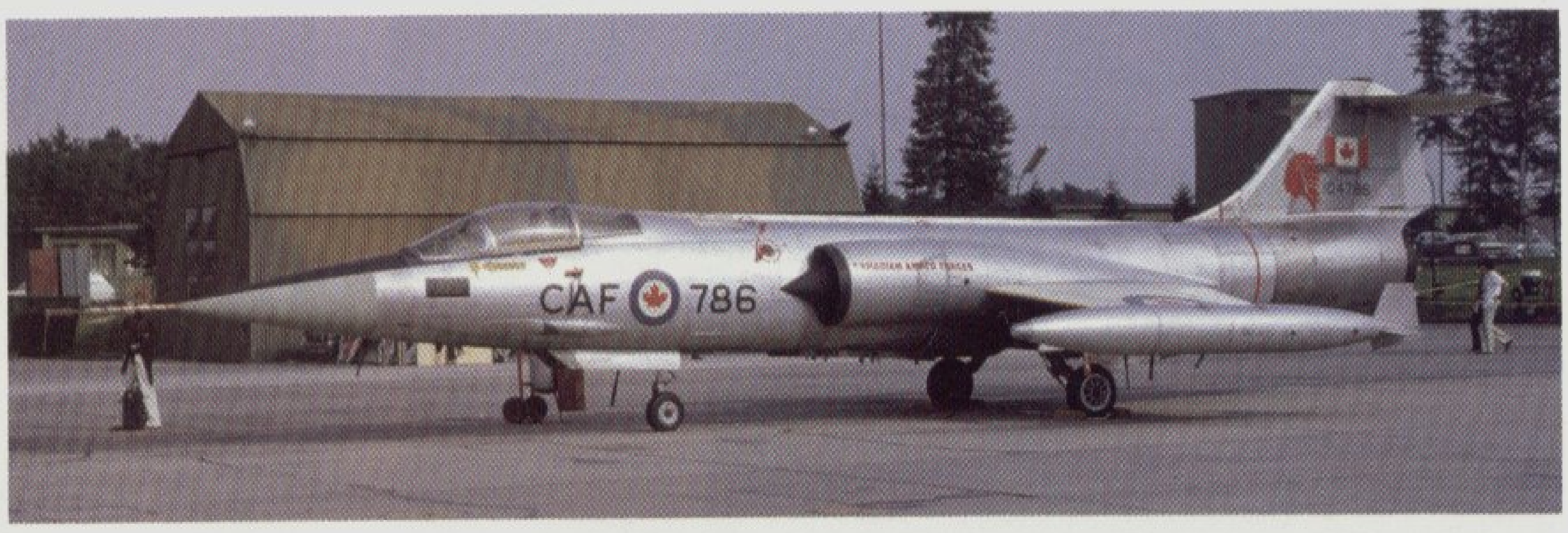
FOREIGN STARFIGHTER COLORS



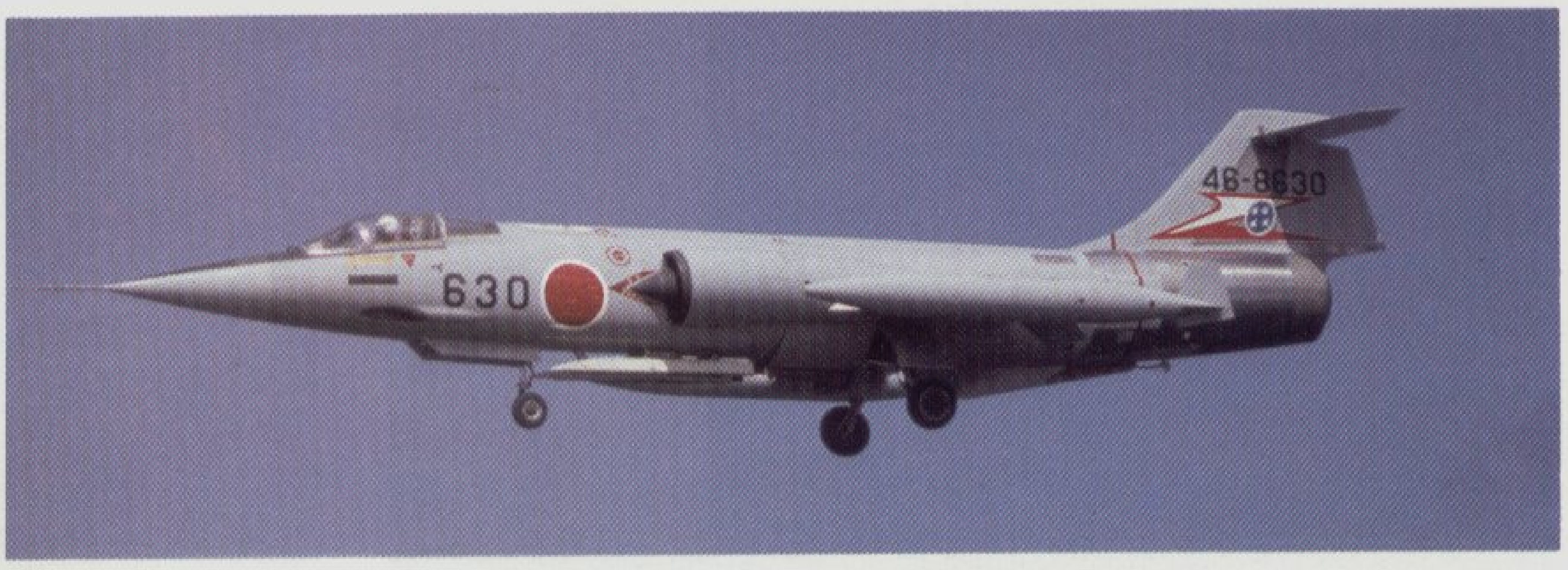
This F-104G carries the markings of the German Navy. A practice bomb dispenser is attached to the centerline station, and the small blue practice bombs are visible.
(Weisse via Flightleader)



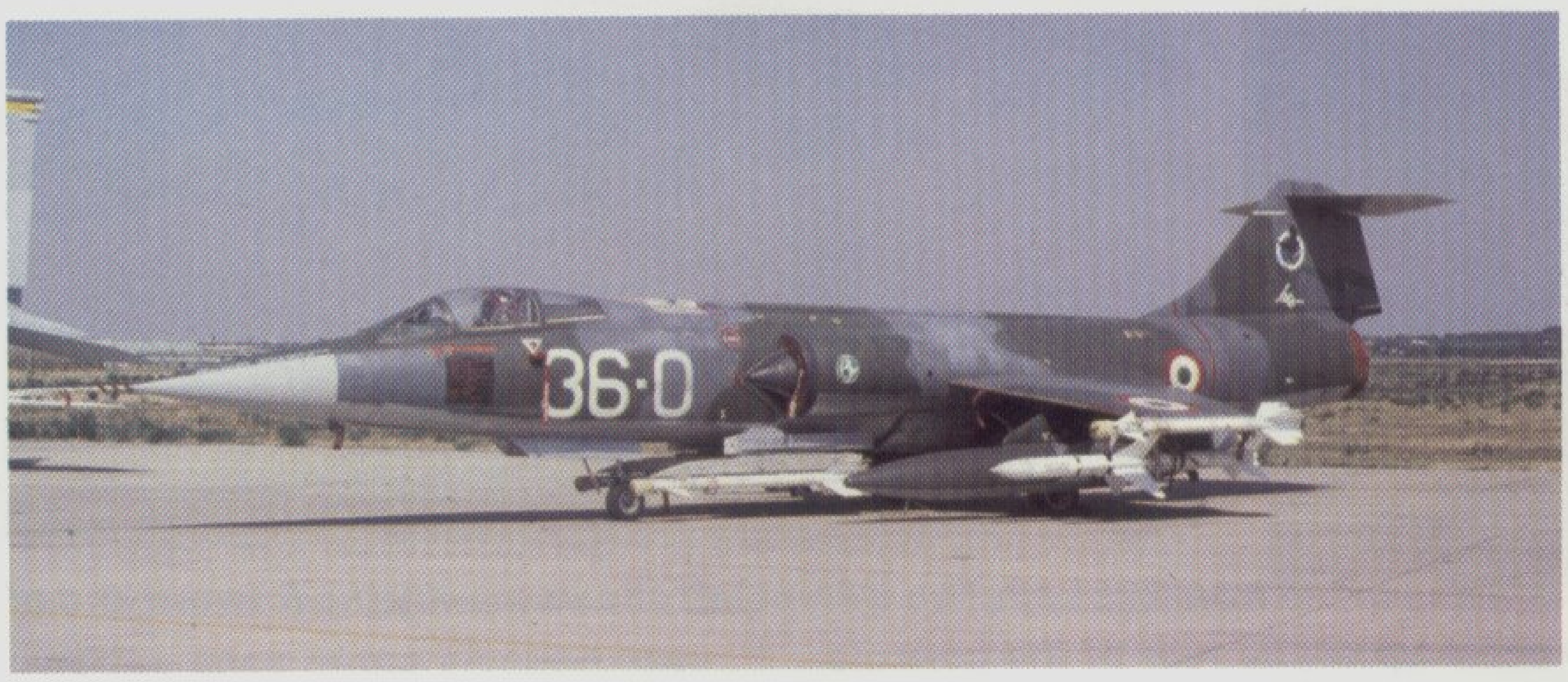
Also belonging to the German Navy is this TF-104G which is fitted with wing tip and underwing fuel tanks.
(Munkasy)



This CF-104 has a red Indian head on its vertical tail indicating that it is from the 421 Red Indian Squadron that was based in France.
(Wood via Munkasy)

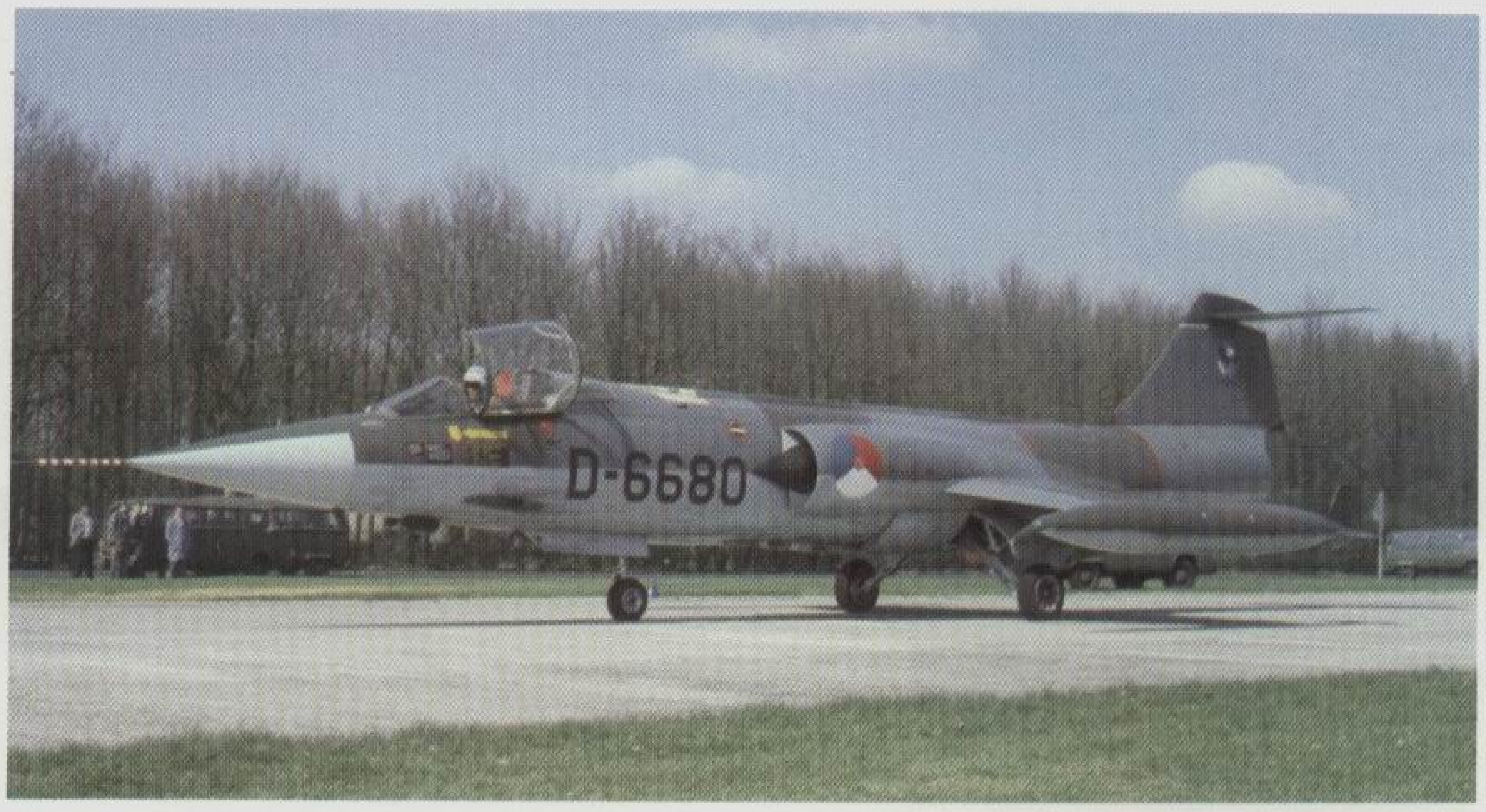


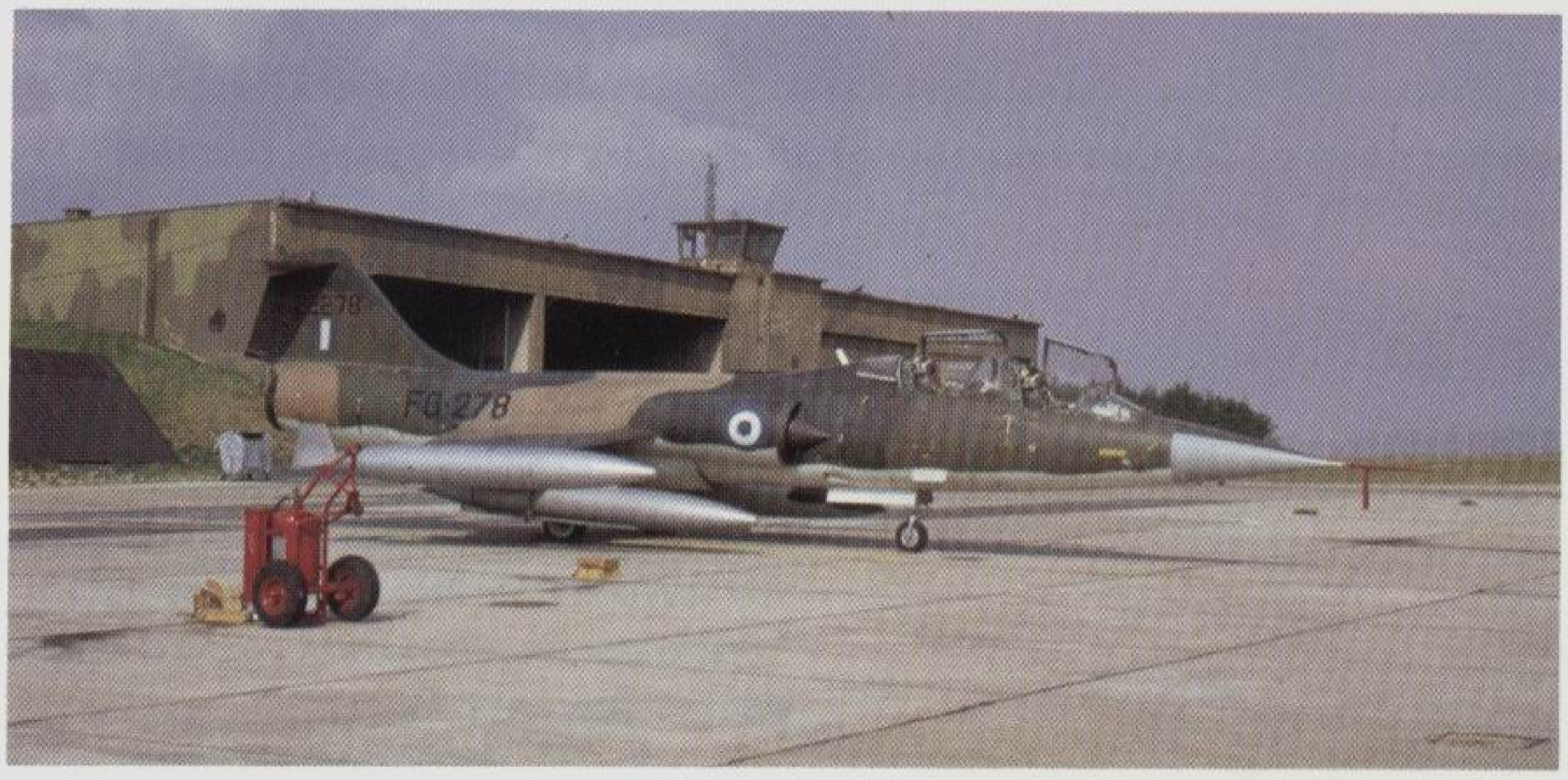
A Japanese F-104J from 207 Squadron is shown making its approach to landing at Naha Air Base in August 1978. Note the two Sidewinder missile rails under the fuselage.
(Flightleader)



Ready for the air defense mission, this Italian F-104S is armed with two AIM-7 Sparrow and four AIM-9 Sidewinder missiles. The Sidewinders are on the wing tips and under the fuselage, while the larger Sparrows are located under the wings. *(Flightleader)*

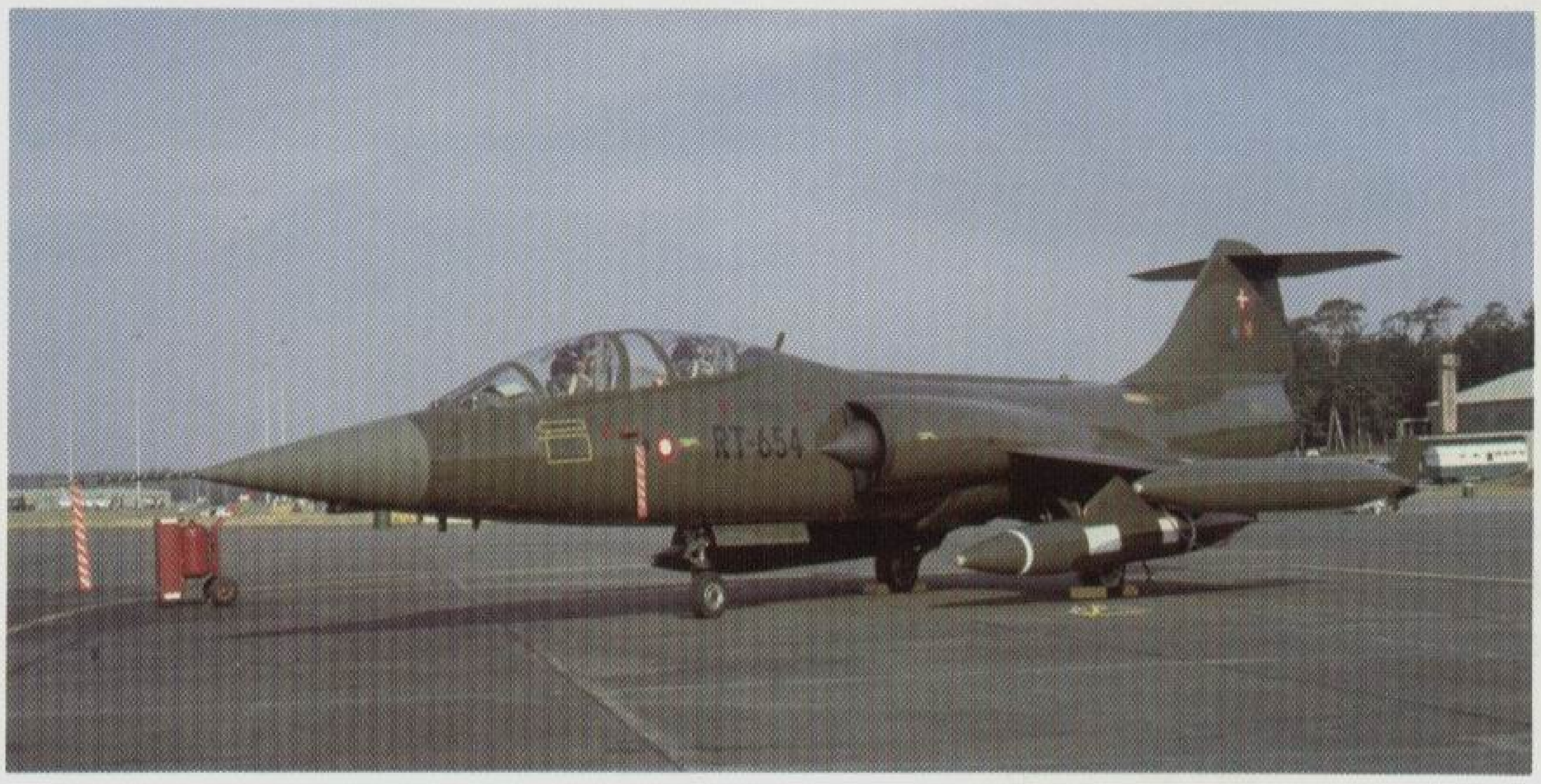
An F-104G from 311 Squadron of the Dutch Air Force is shown here as it taxied in from a training mission. This photograph was taken on April 14, 1982. (Flightleader)

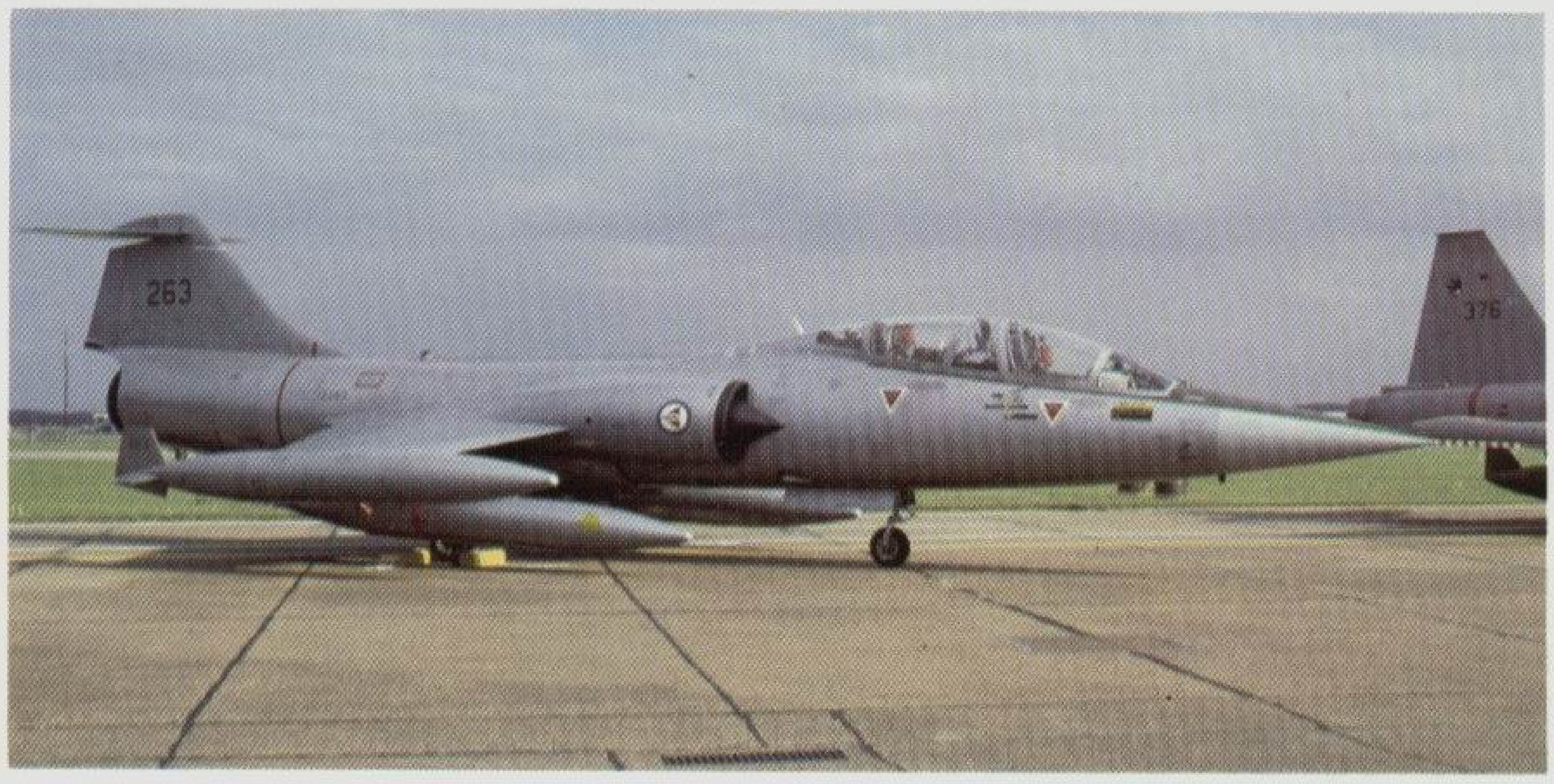




Greek Air Force markings are illustrated on this TF-104G that was photographed on June 26, 1974, at Bitburg AB, Germany. The paint scheme's pattern and colors are essentially the same as the standard USAF camouflage scheme. (Knowles via Leader)

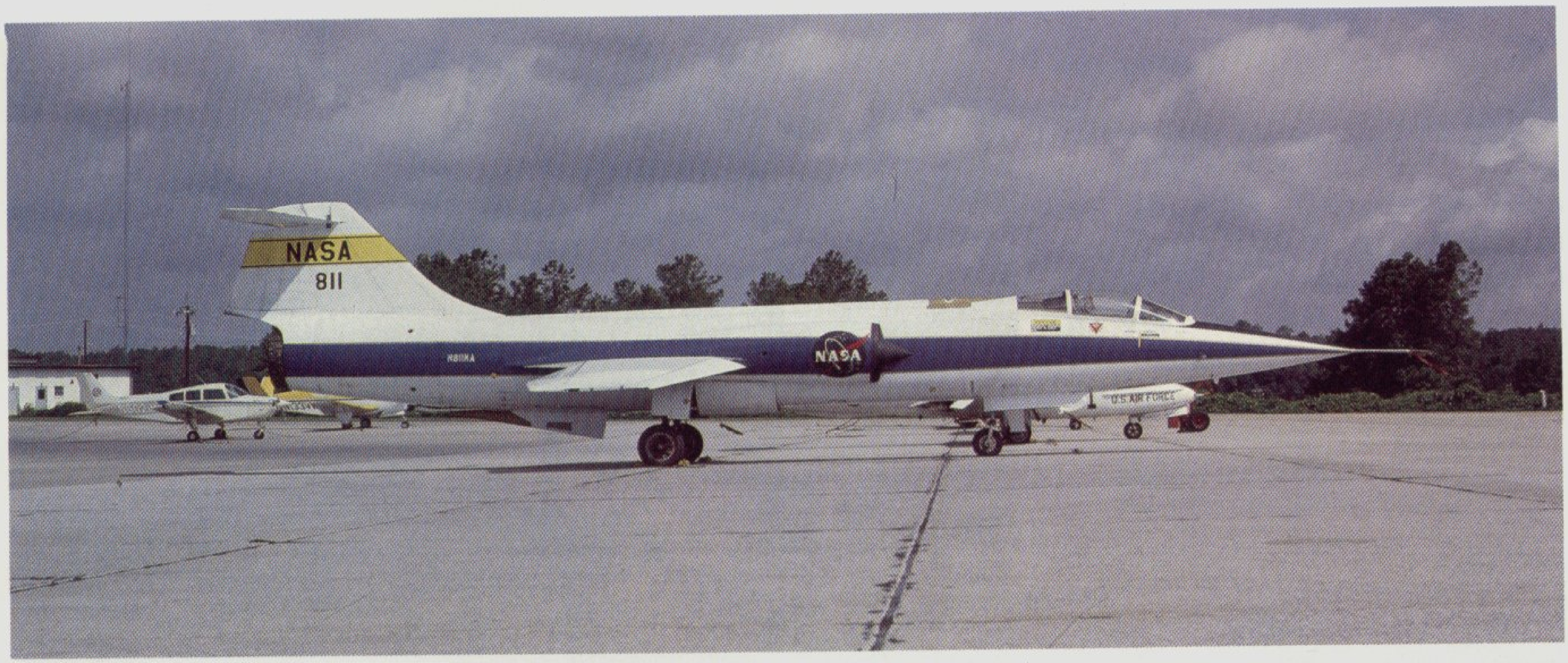
This TF-104G carries the markings of the Norwegian Air Force, and is painted in an overall silver lacquer scheme. (Flightleader)



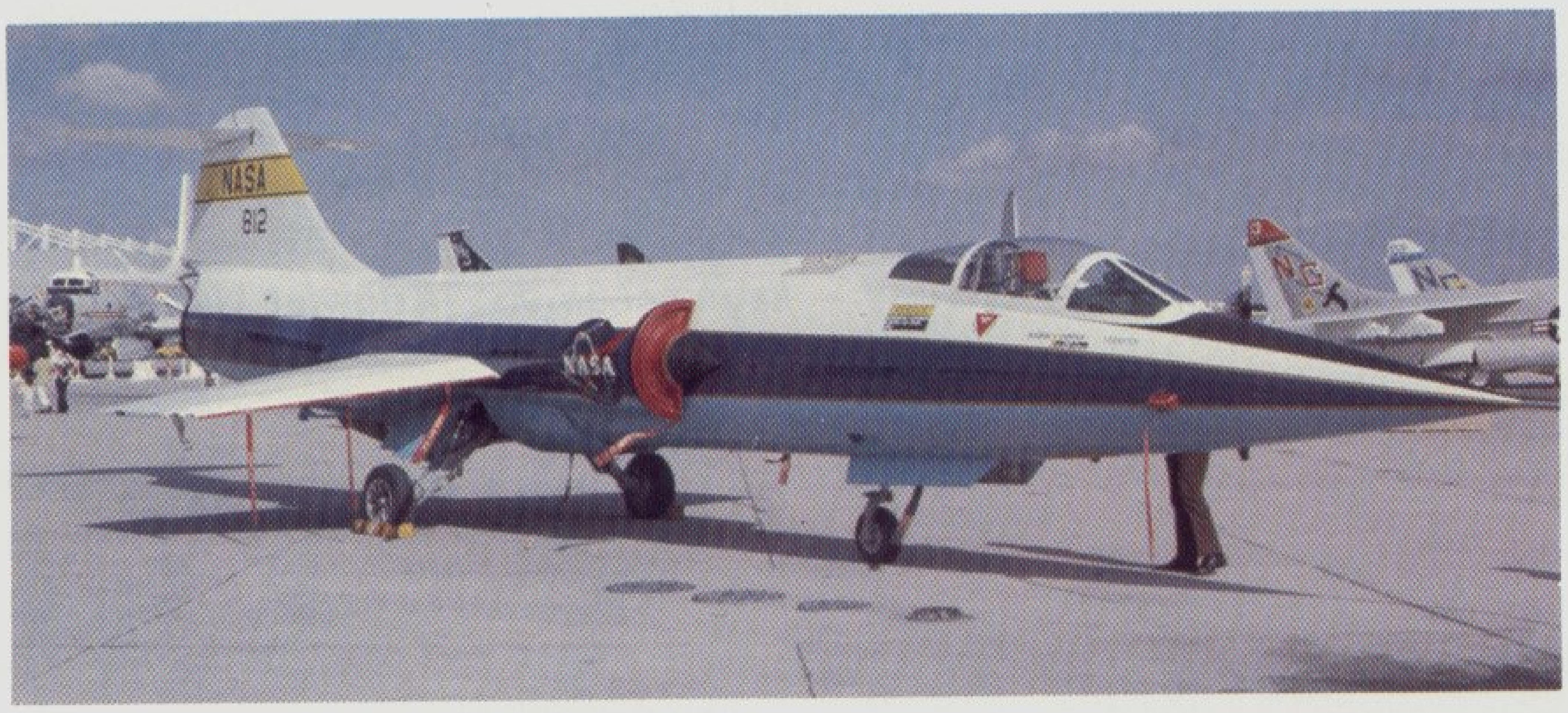


An overall olive green scheme has been applied to this TF-104G that belongs to the Belgian Air Force. It was photographed at Ramstein AB, Germany, on August 5, 1979. (Flightleader)

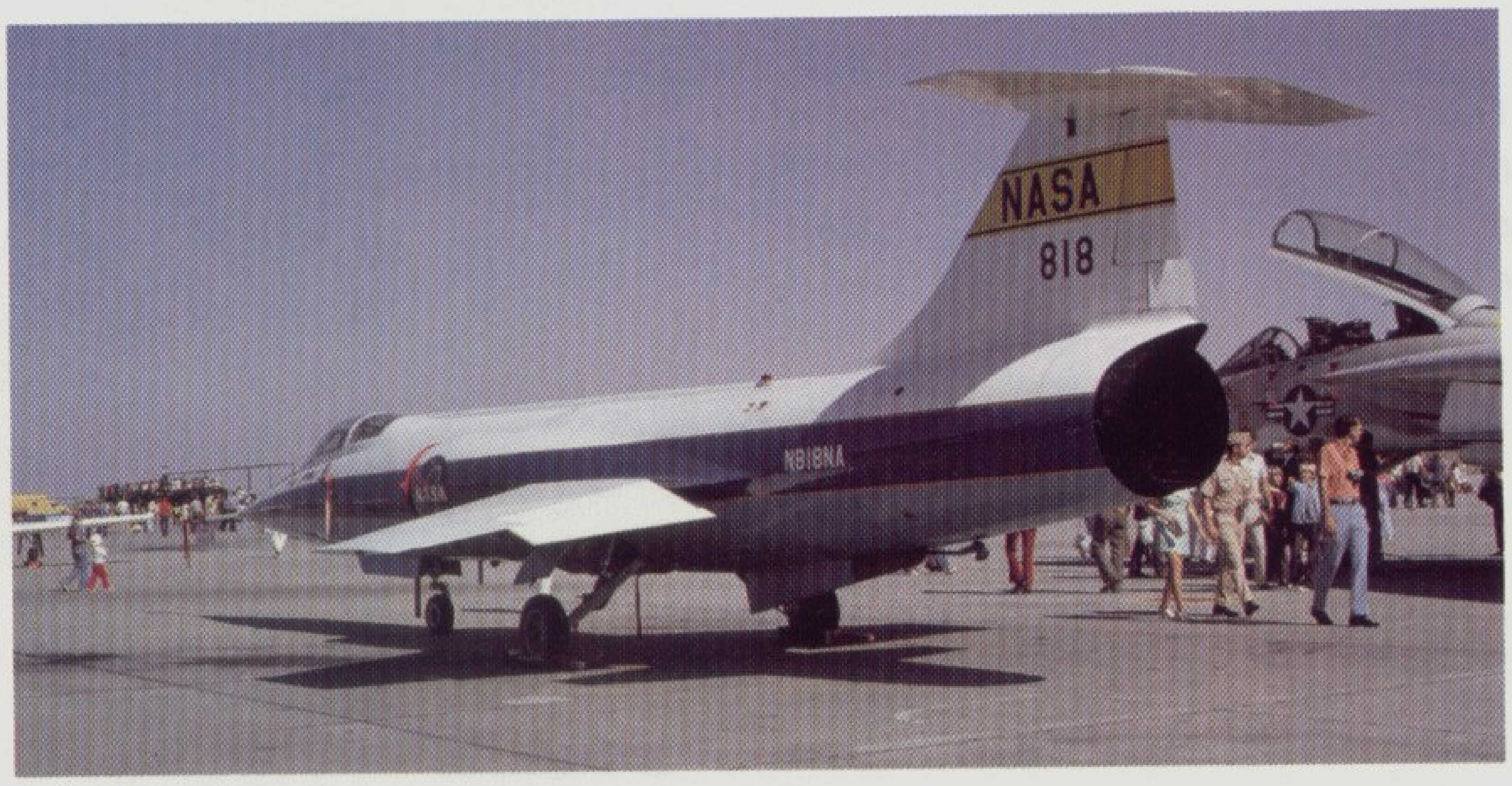
NASA STARFIGHTERS



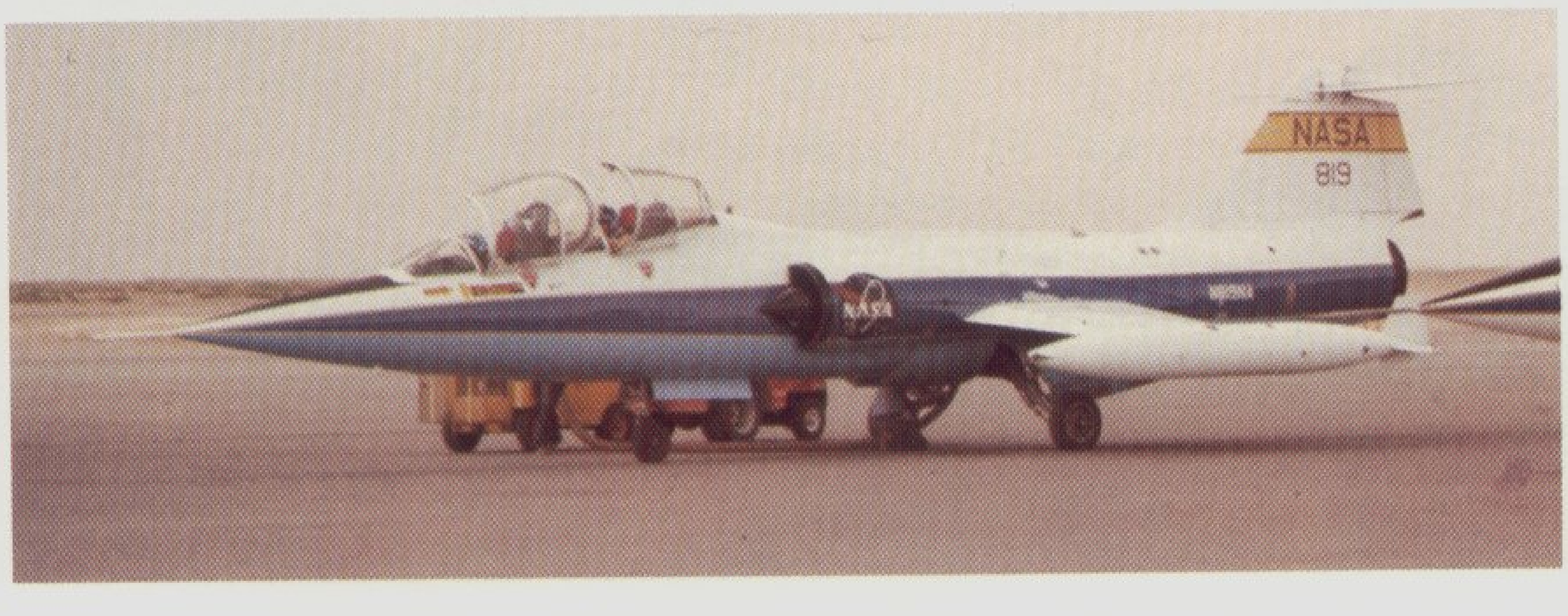
The National Aeronautics and Space Administration has operated a number of Starfighters over the years. Number 811 was photographed on July 28, 1979, at Dobbins AFB, Georgia. *(Leader)*



Number 812 was photographed at NAS Lemoore, California, in October 1975. Note that this aircraft has a light blue lower fuselage rather than a white one as seen above. *(Wood via Munkasy)*



Also sporting a light blue lower fuselage, 818 put in an appearance at an open house display at NAS Lemoore. *(Munkasy)*

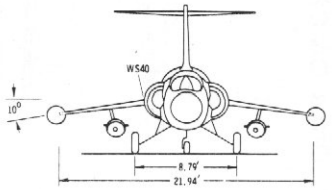


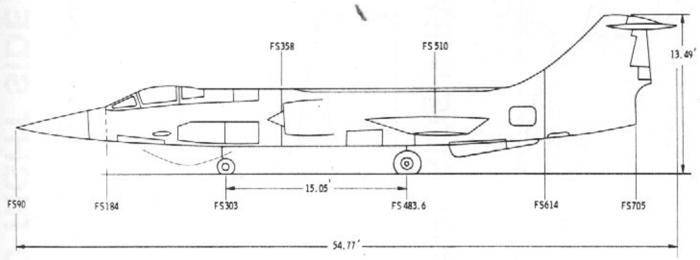
NASA also flew the two-seat F-104 as seen here in the form of number 819. It too has the light blue lower fuselage. The NASA two-seater was seldom seen without tip tanks.

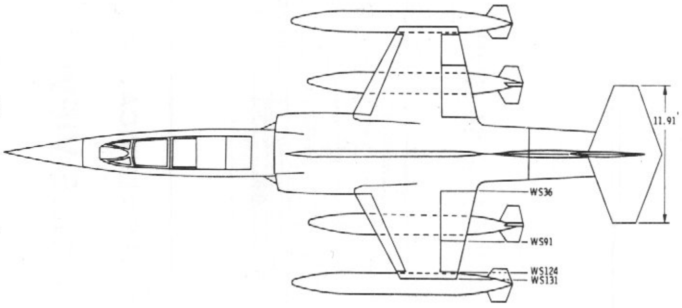
DIMENSIONS & DRAWINGS

MEASUREMENT	ACTUAL	1/72nd SCALE*	1/48th SCALE	1/32nd SCALE
Length (XF-104)	49.17′	8.20″	12.29″	18.44″
Length (All except XF-104)	54.77′	9.13″	13.69′	20.54″
Wingspan (Without tip tanks)	21.94′	3.66″	5.49″	8.23″
Span of horizontal stabilizer	11.91′	1.99″	2.98″	4.47″
Height	13.49′	2.25″	3.37″	5.06″
Wheel Track	15.05′	2.51″	3.76″	5.64″
Wheel Tread	8.79′	1.47″	2.20″	3.30″

*For dimensions in 1/144th scale, divide 1/72nd scale dimensions in half. Scale measurements are to the nearest 1/100th of an inch.







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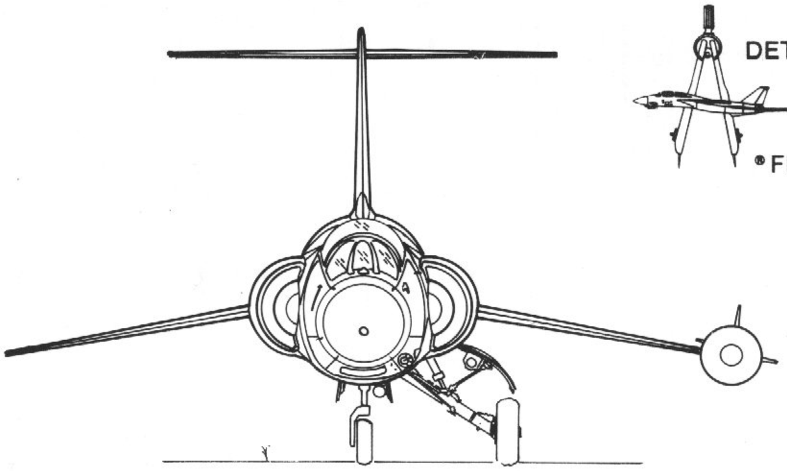
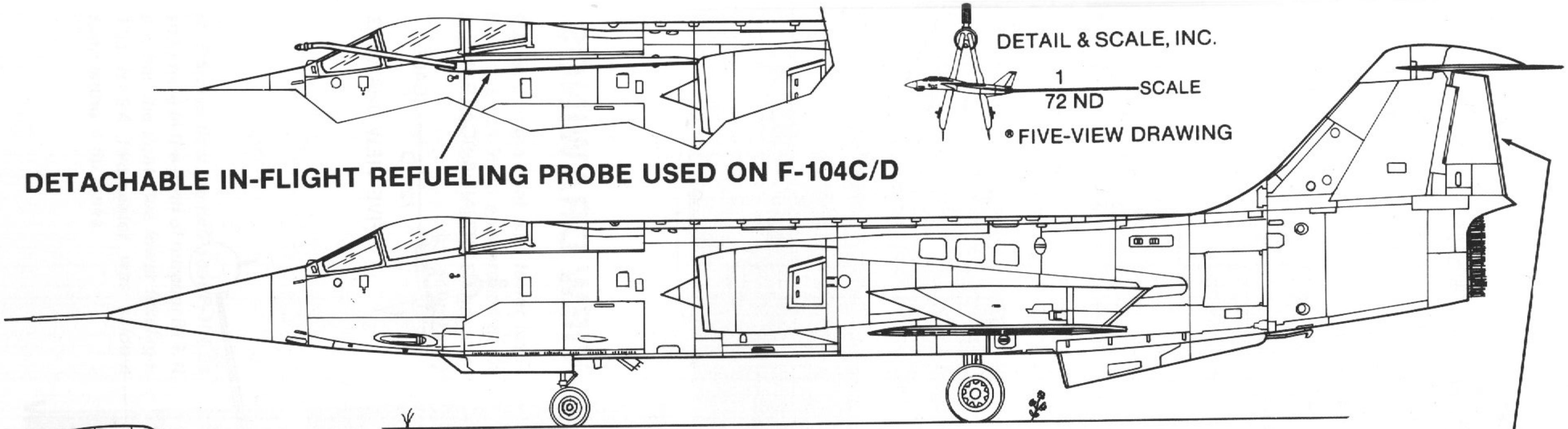


Dana Bell

F-104A/C FRONT VIEW



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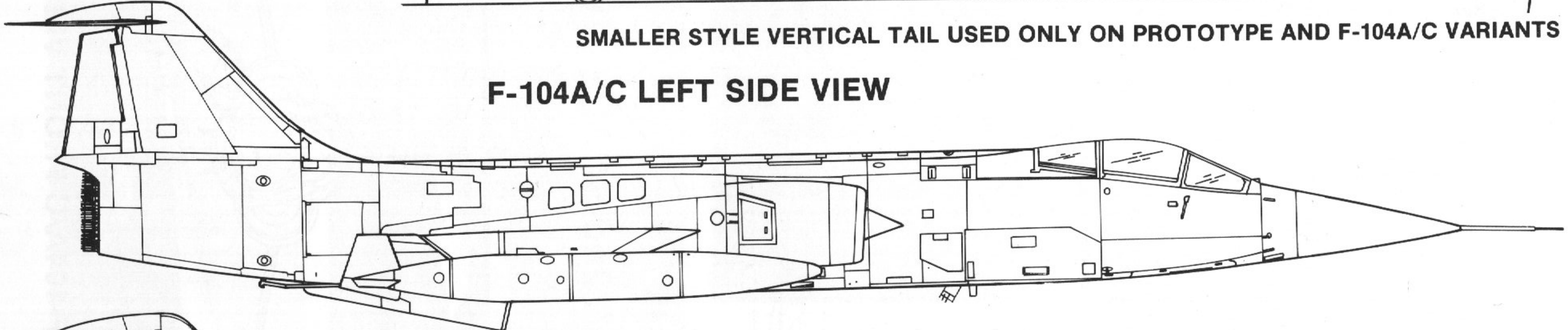
DETACHABLE IN-FLIGHT REFUELING PROBE USED ON F-104C/D

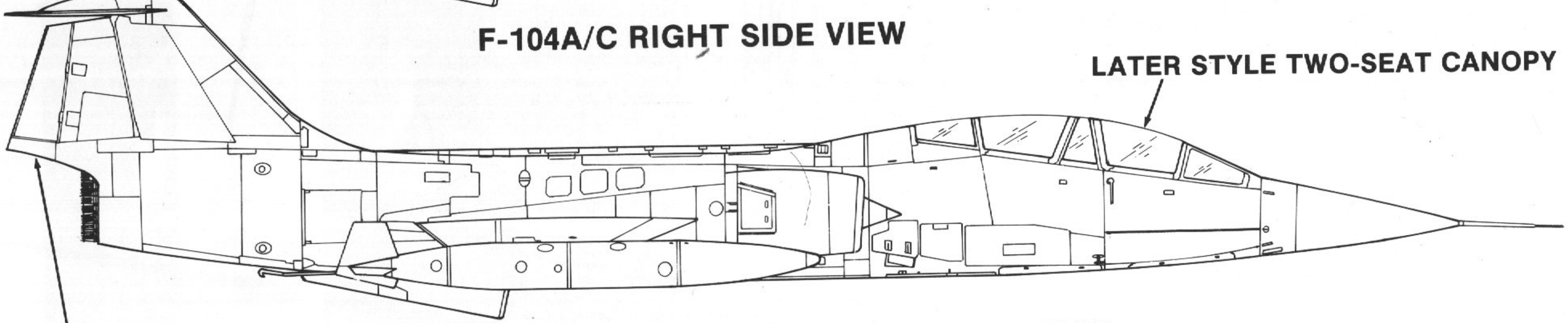
SMALLER STYLE VERTICAL TAIL USED ONLY ON PROTOTYPE AND F-104A/C VARIANTS

F-104A/C LEFT SIDE VIEW



F-104A/C RIGHT SIDE VIEW

LATER STYLE TWO-SEAT CANOPY

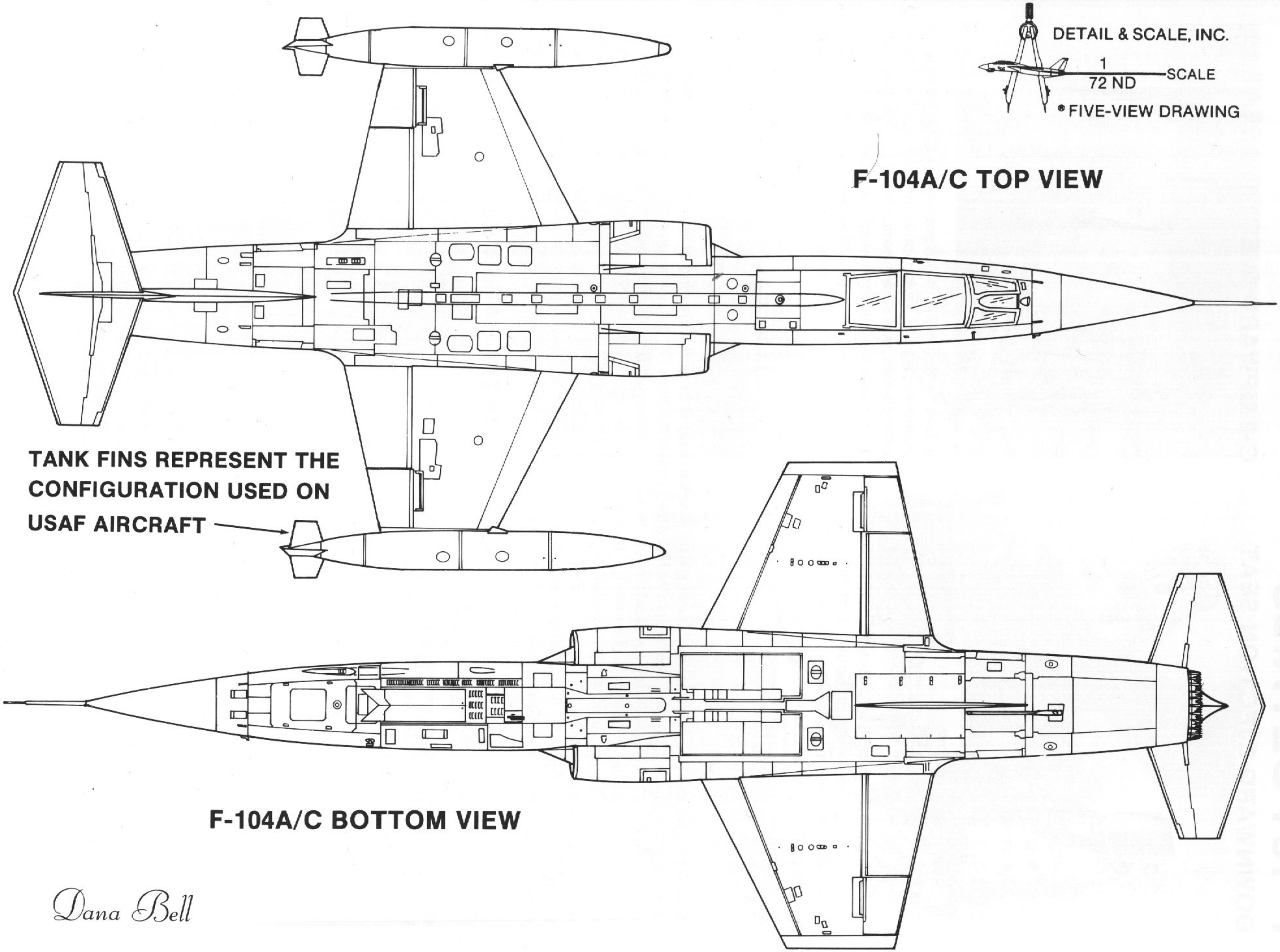


LARGER STYLE VERTICAL TAIL USED ON ALL VARIANTS EXCEPT PROTOTYPES AND F-104A/C AIRCRAFT

F-104B/D RIGHT SIDE VIEW

Dana Bell

DETAIL & SCALE, INC.
$\frac{1}{72}$ ND SCALE
® FIVE-VIEW DRAWING



F-104A/C TOP VIEW

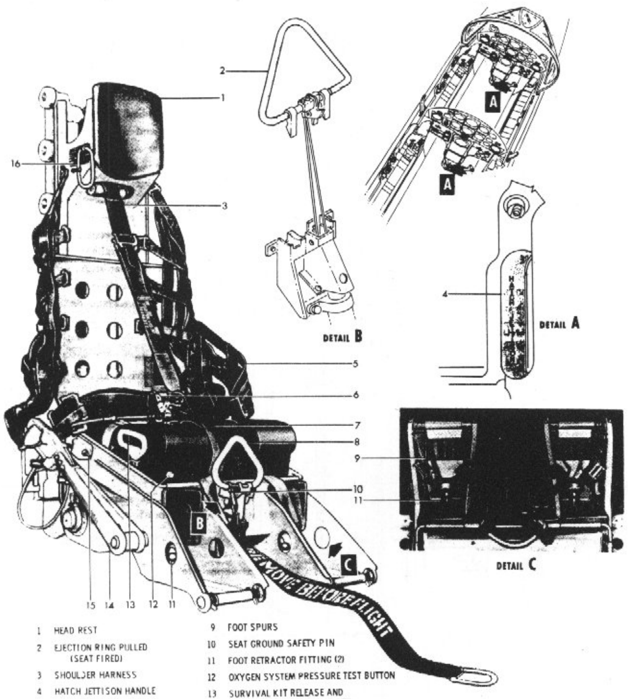
TANK FINS REPRESENT THE CONFIGURATION USED ON USAF AIRCRAFT

F-104A/C BOTTOM VIEW

Dana Bell

F-104 DETAILS

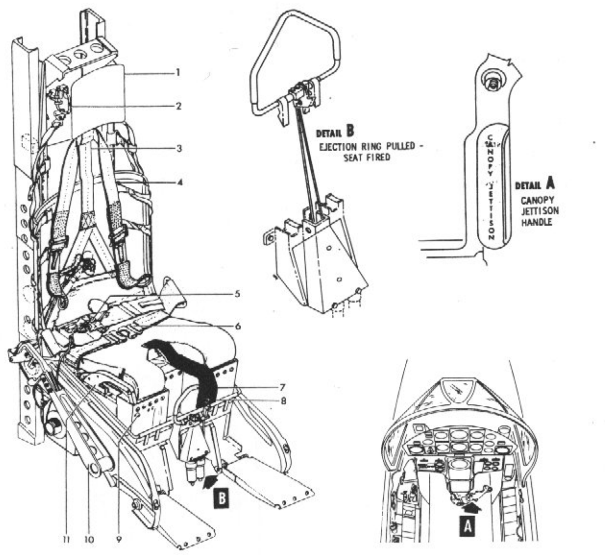
DOWNWARD EJECTION SEAT



1	HEAD REST	9	FOOT SPURS
2	EJECTION RING PULLED (SEAT FIRED)	10	SEAT GROUND SAFETY PIN
3	SHOULDER HARNESS	11	FOOT RETRACTOR FITTING (2)
4	HATCH JETTISON HANDLE	12	OXYGEN SYSTEM PRESSURE TEST BUTTON
5	ARM NET	13	SURVIVAL KIT RELEASE AND LIFE RAFT ACTUATION HANDLE
6	AUTOMATIC OPENING SEAT BELT	14	KNEE GUARD
7	TIE-DOWN STRAP	15	VERTICAL ADJUSTMENT SWITCH
8	EJECTION RING	16	MANUAL CABLE CUTTER RING

EJECTION SEAT DETAILS

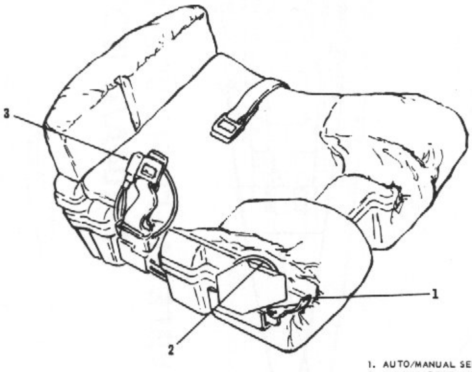
C-2 UPWARD EJECTION SEAT



1	HEAD REST	7	EJECTION RING
2	MANUAL CABLE CUTTER RING	8	SEAT GROUND SAFETY PIN
3	PILOT-SEAT SEPARATOR	9	OXYGEN SYSTEM PRESSURE TEST BUTTON
4	SHOULDER HARNESS	10	KNEE GUARD (STOWED POSITION)
5	AUTOMATIC SEAT BELT	11	SURVIVAL KIT RELEASE HANDLE
6	SURVIVAL KIT ATTACHMENT STRAP		

The F-104 was originally fitted with the downward ejection seat seen in the drawing at left. This was because it was feared that an upward ejection seat would not be able to clear the high "T" tail of the aircraft, and the pilot would be injured or killed by the tail striking the seat as it left the aircraft. However, the downward ejection seat proved to be more dangerous, and could not be used at all during takeoffs, landings, or anytime the aircraft was flying near the ground. After fatalities occurred as pilots ejected into the ground with the downward ejection seat, a rocket propelled upward ejection seat was developed that could safely clear the tail of the aircraft. Upward ejection seats were installed into all subsequent aircraft as they were produced, and retrofitted to those aircraft that were still operational with the downward ejection seat. The C-2 upward ejection seat is illustrated in the drawing at right. (Both drawings, USAF)

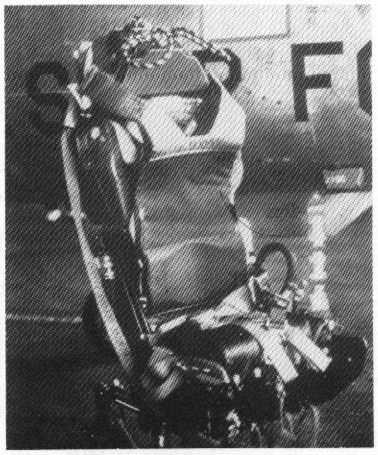
EJECTION SEAT SURVIVAL KIT



1. AUTO/MANUAL SELECTOR LEVER.
2. MANUAL RELEASE HANDLE.
3. PARACHUTE OPENING SENSOR CONNECTION.

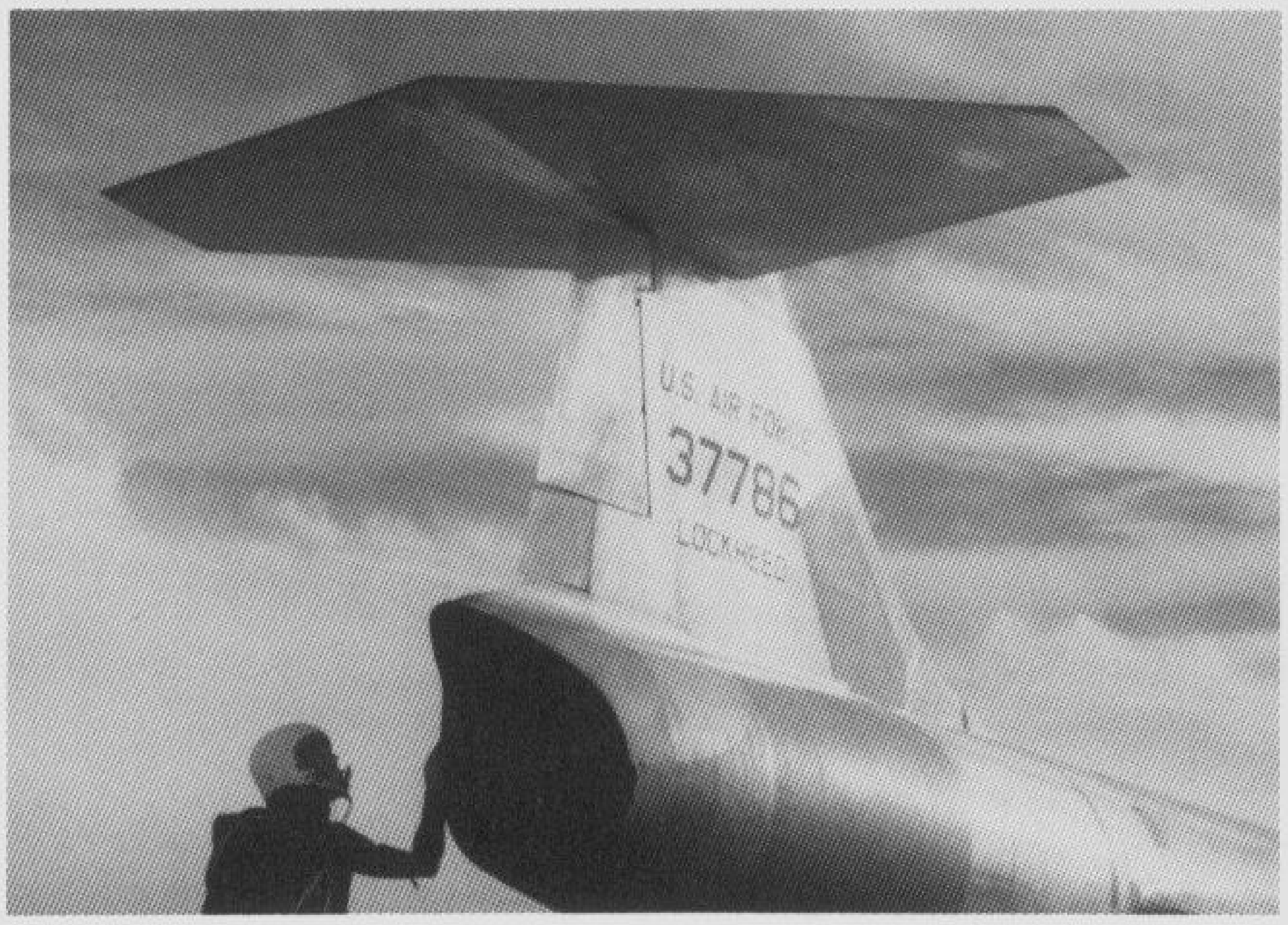
This is the survival kit used in the seat of the F-104. (USAF)

MARTIN-BAKER EJECTION SEAT

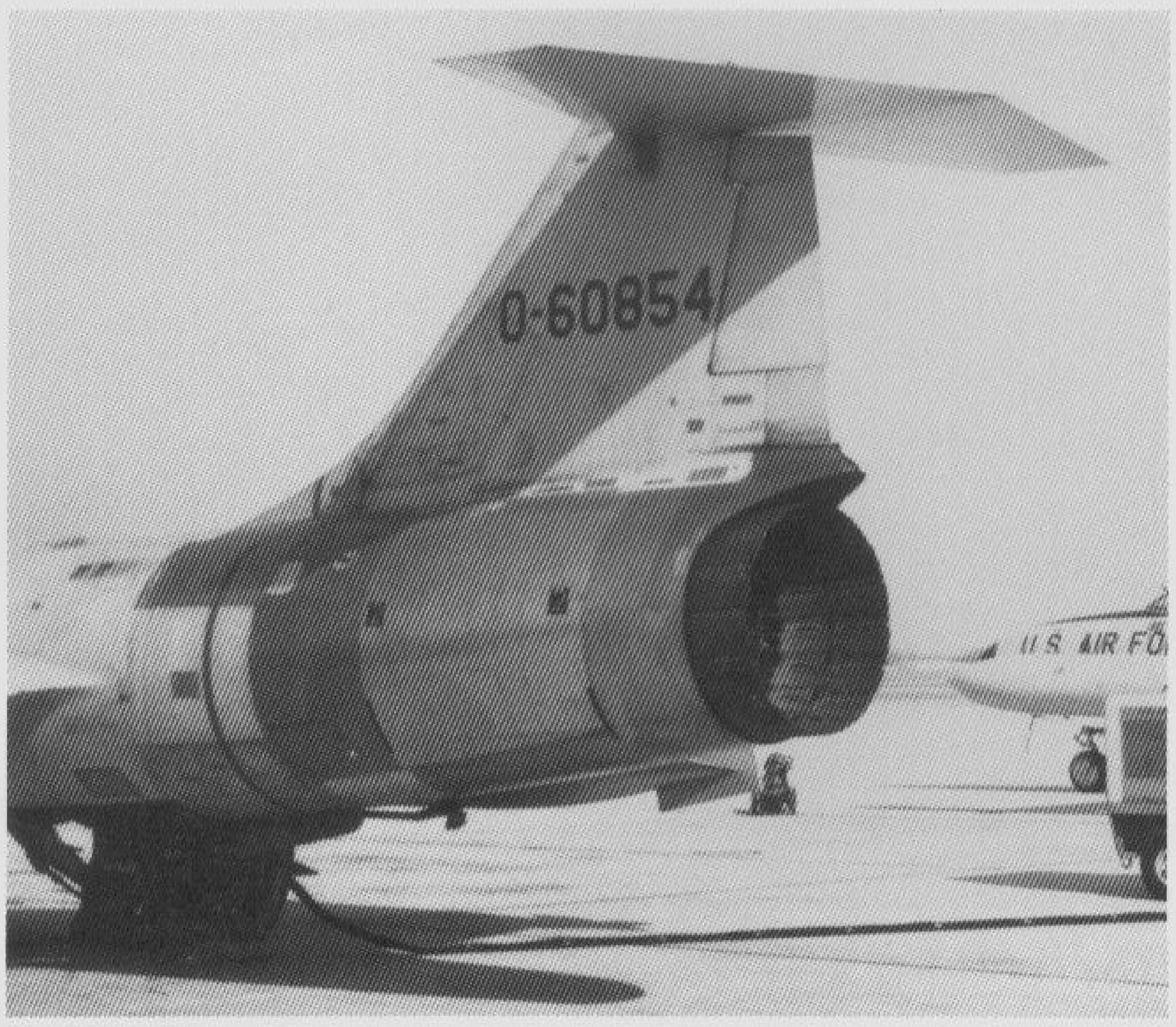


A Martin-Baker Q5 upward ejection seat, removed from a German F-104G, is shown in this photograph. This seat was used on German, Dutch, and Belgian Starfighters. All other nations chose the Lockheed C-2 seat shown above as the upward ejection seat for their F-104s. (Hebrok collection)

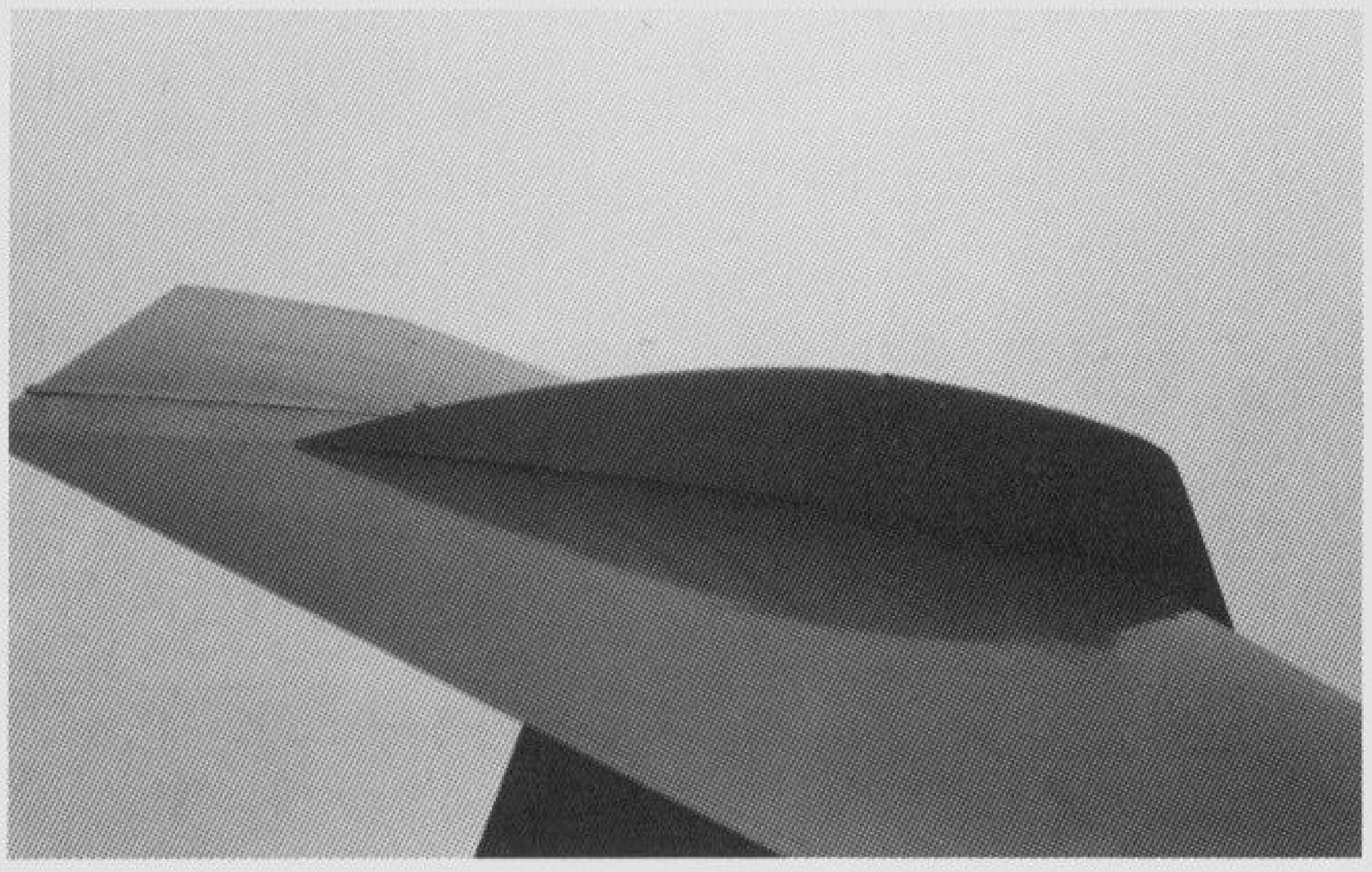
TAIL DETAILS



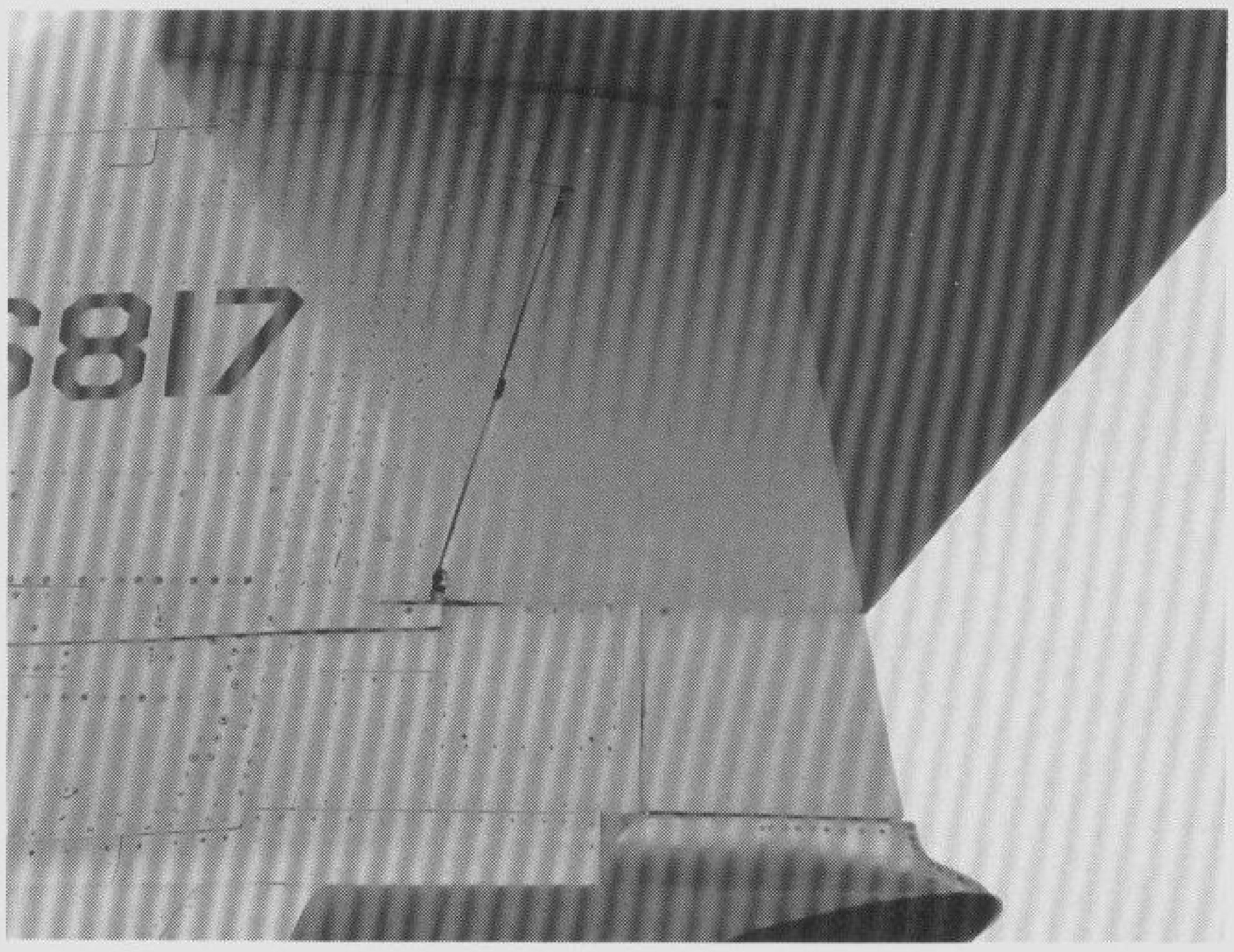
Single-seat USAF versions of the Starfighter had a smaller vertical tail and rudder than all other versions. The vertical tail of the first prototype is seen here from the behind and to the right. The horizontal tail is also clearly illustrated. It had an area of 48.2 square feet, a root chord of seventy-four inches, and a tip chord of twenty-three inches. (Lockheed via Jones)



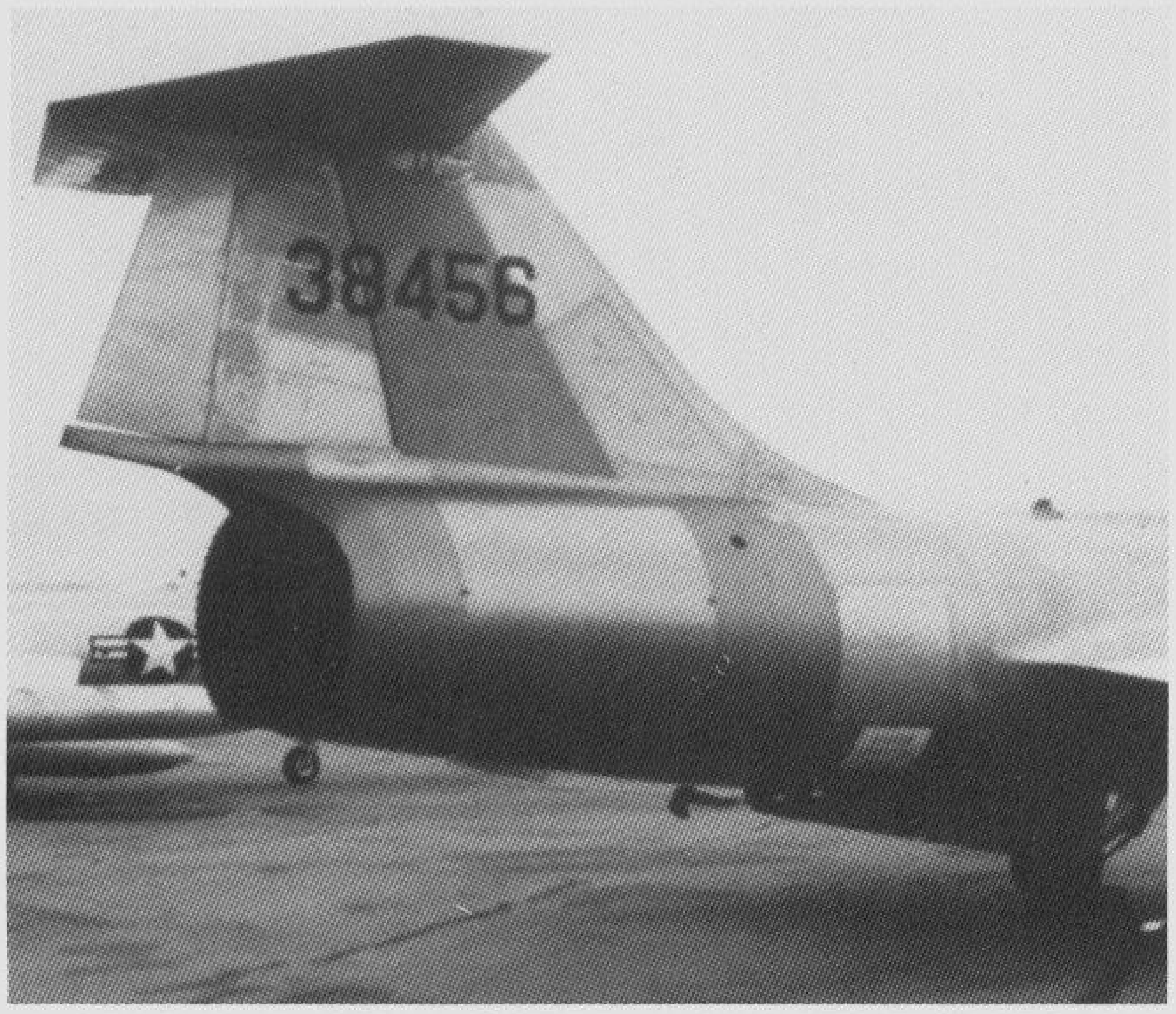
The vertical tail on F-104As and F-104Cs differed very slightly from that used on the prototypes. The vertical tail had an area of 35.1 square feet. Root chord was 112.5 inches, and tip chord was 41.71 inches. (Flightleader)

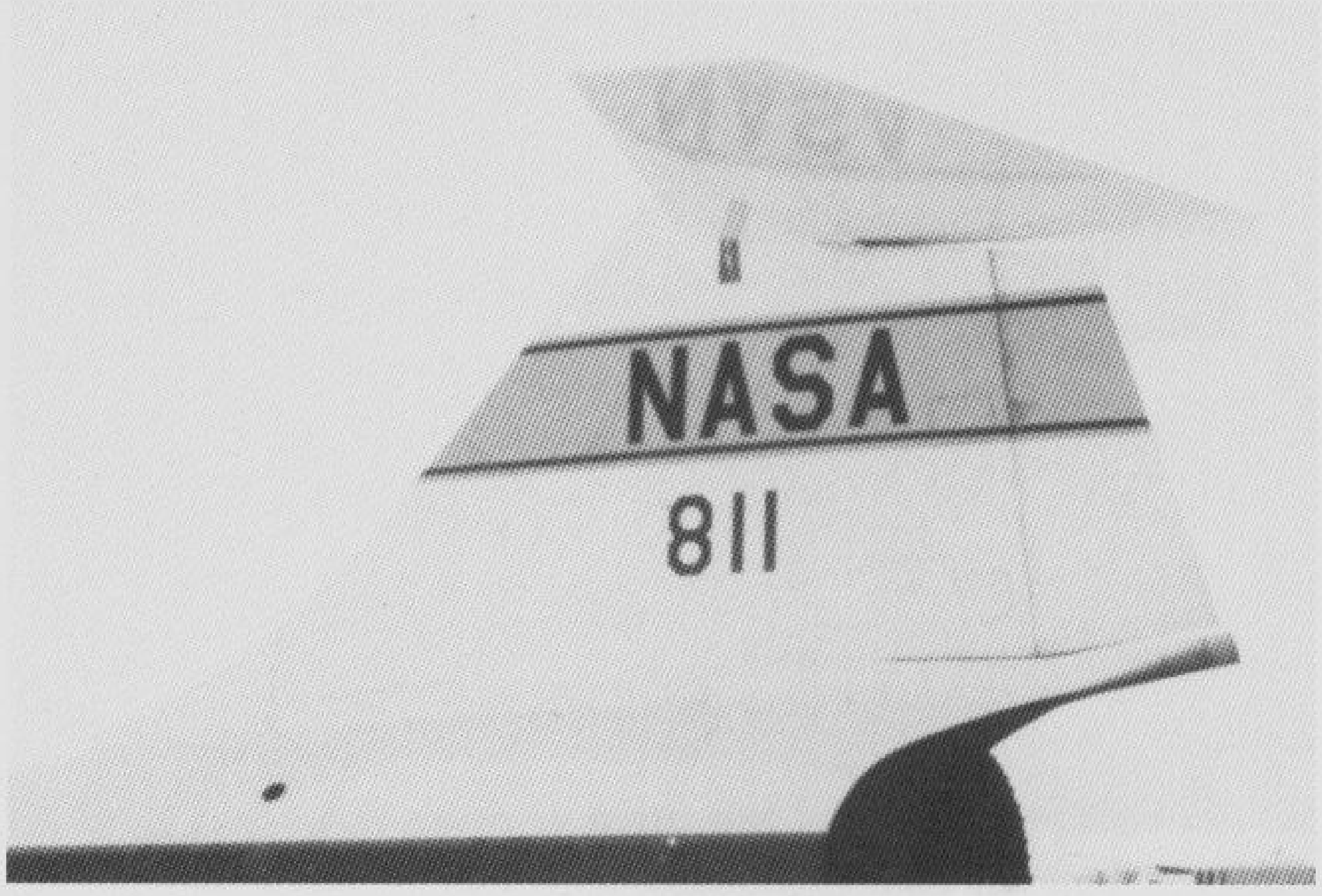


The portion of the vertical tail that was above the horizontal tail is shown here.



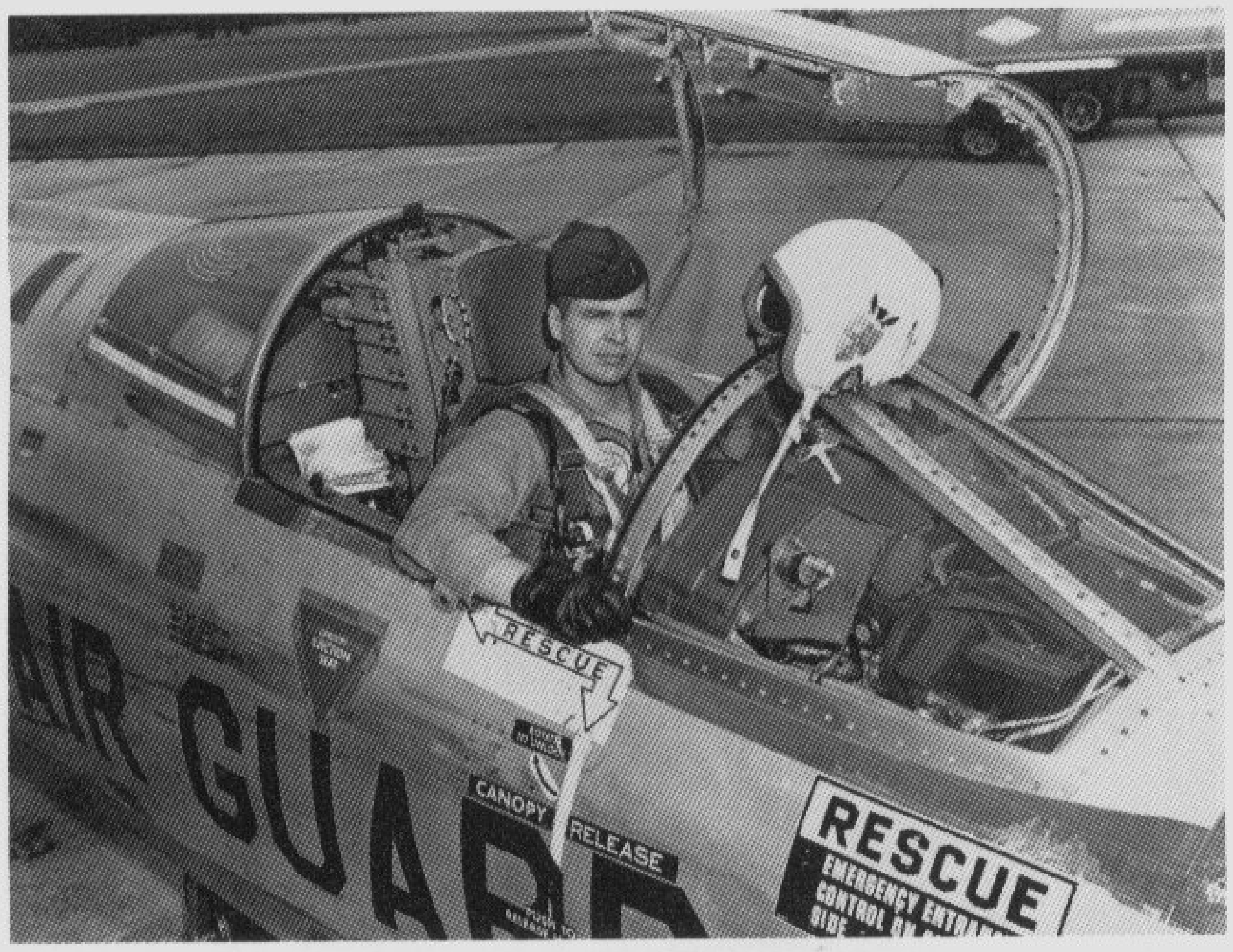
Details of the rudder as used on the F-104A and -C are shown here. The rudder area was 4.3 square feet, and it could be deflected twenty-five degrees left and right.



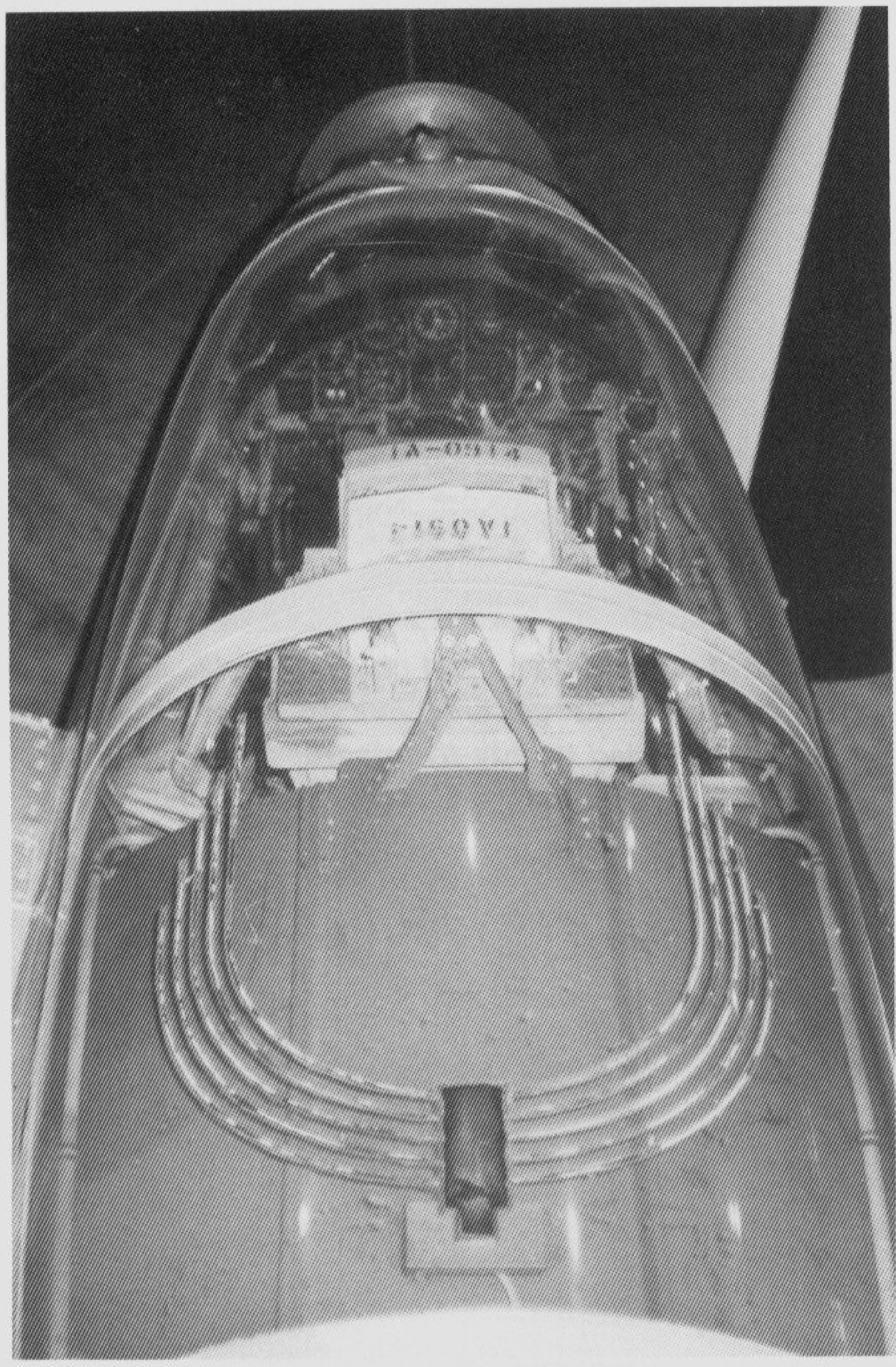


All production Starfighters, except the F-104A and F-104C, had the larger vertical tail and rudder combination seen in these two views.

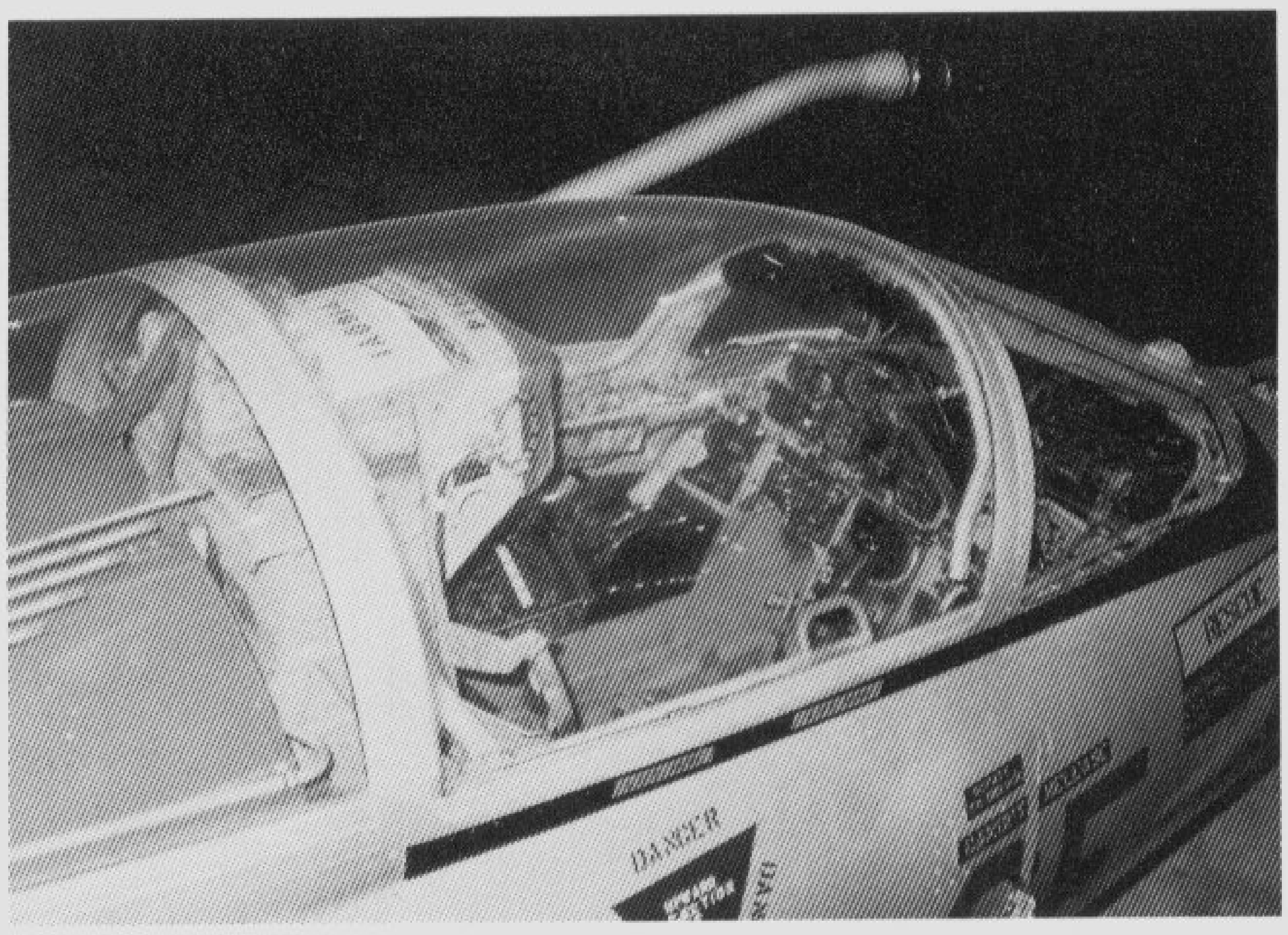
CANOPY DETAILS



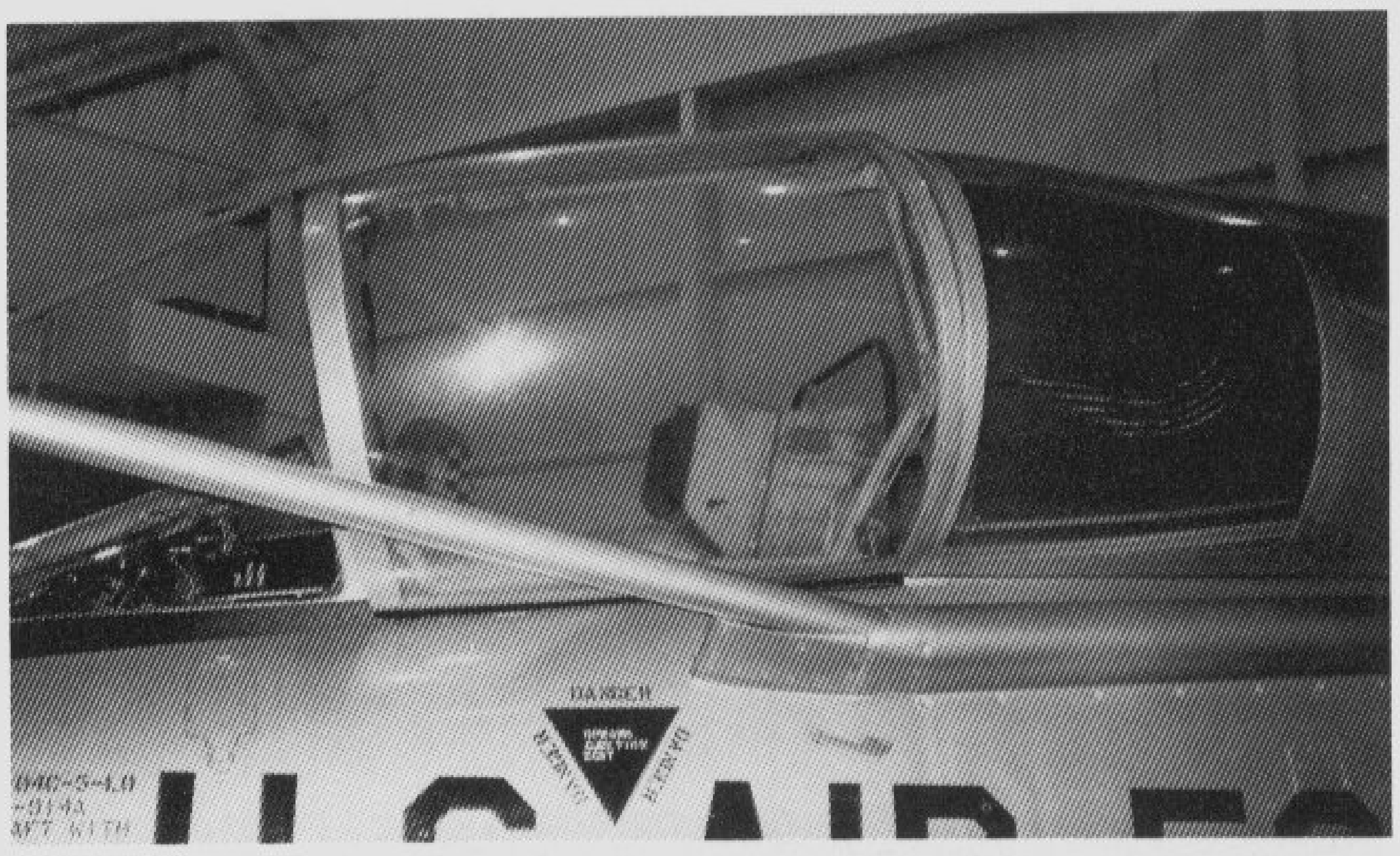
The F-104 was unique among USAF fighters in that it had a canopy hinged on the left side. This meant that entry to the cockpit was from the right side as opposed to the left side, as was the case on other USAF fighters. This photograph shows the hinged canopy, the windscreen and its framing, and the aft canopy glass to good effect.
(Taylor collection)



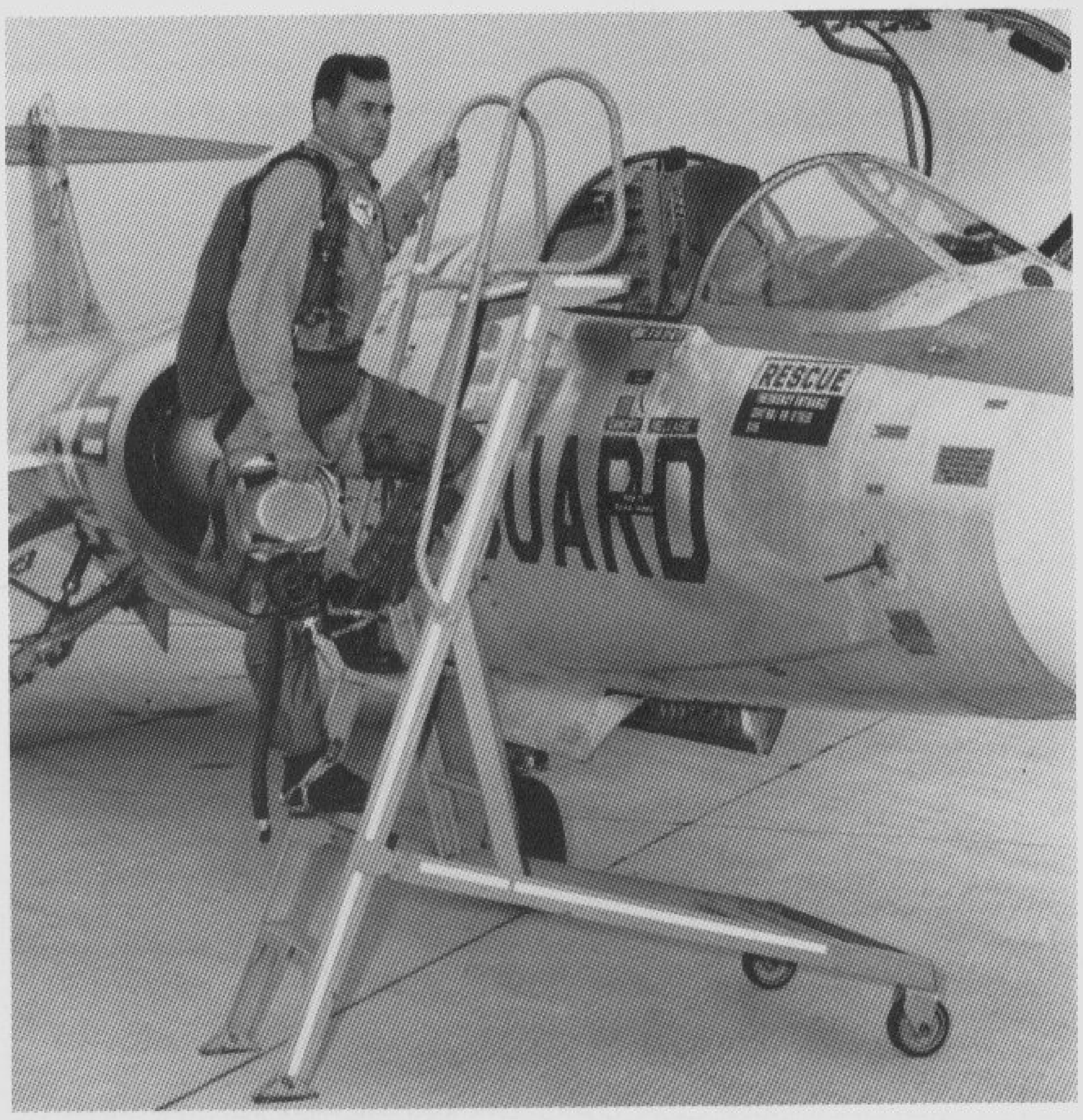
This is the aft canopy glass and the hinged portion as viewed from behind. The antenna stripping in the aft glass is clearly visible.



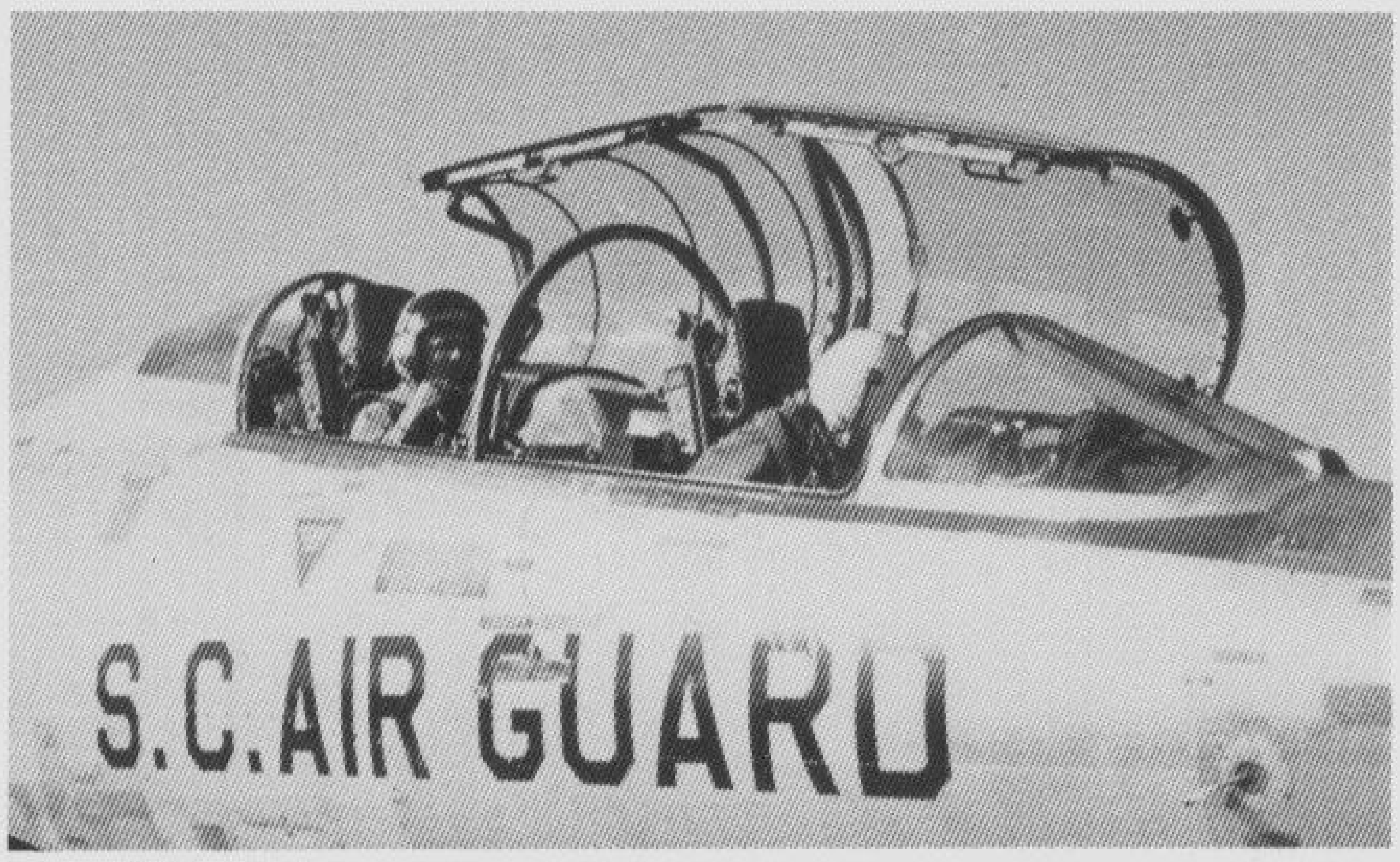
A closed canopy is seen in this view.

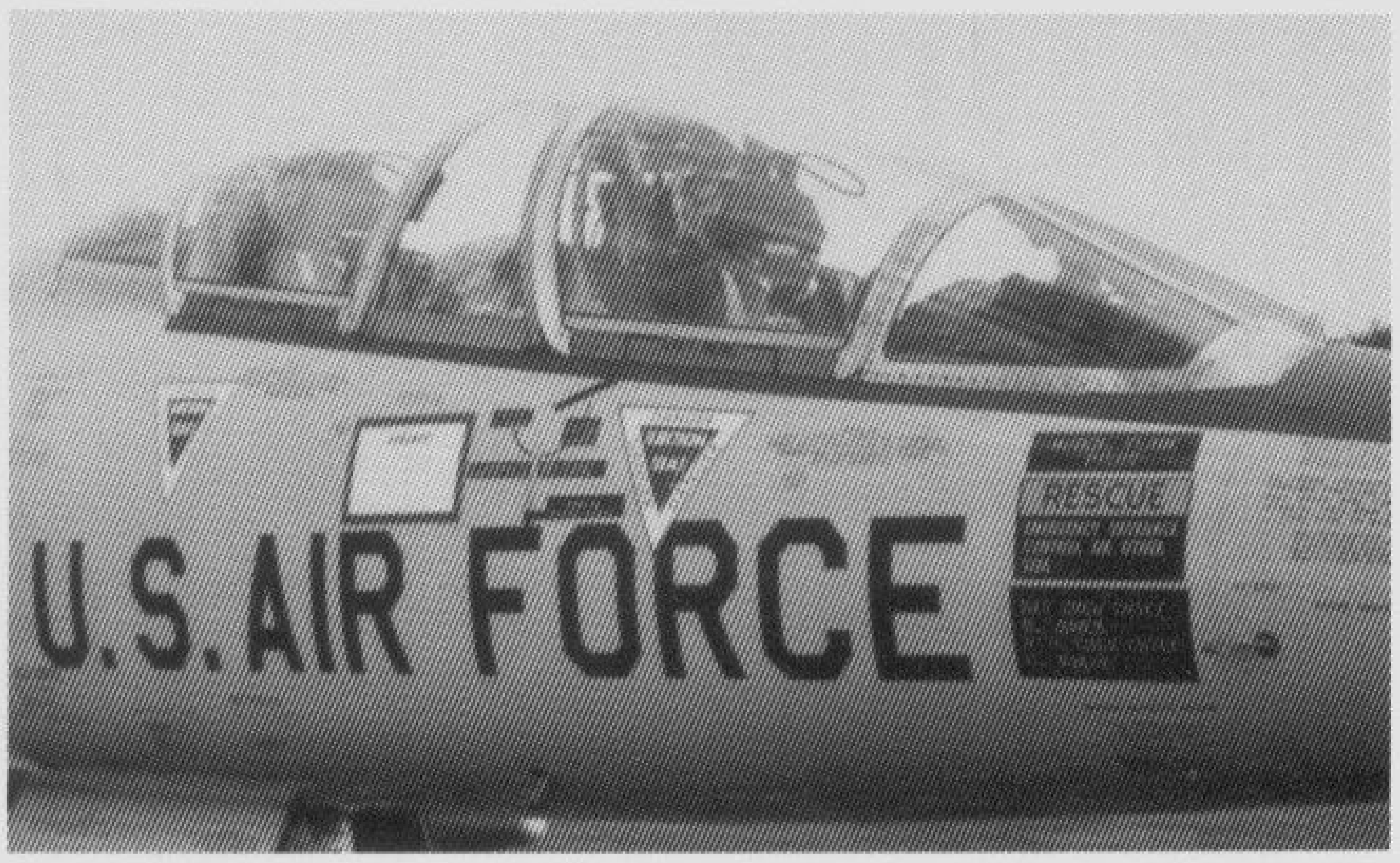


The open canopy is shown from the left side in this photograph. Note that the aft canopy glass is on a hinged portion of the upper fuselage that can be opened to provide access to the avionics bay behind the cockpit in much the same way as the center canopy section.

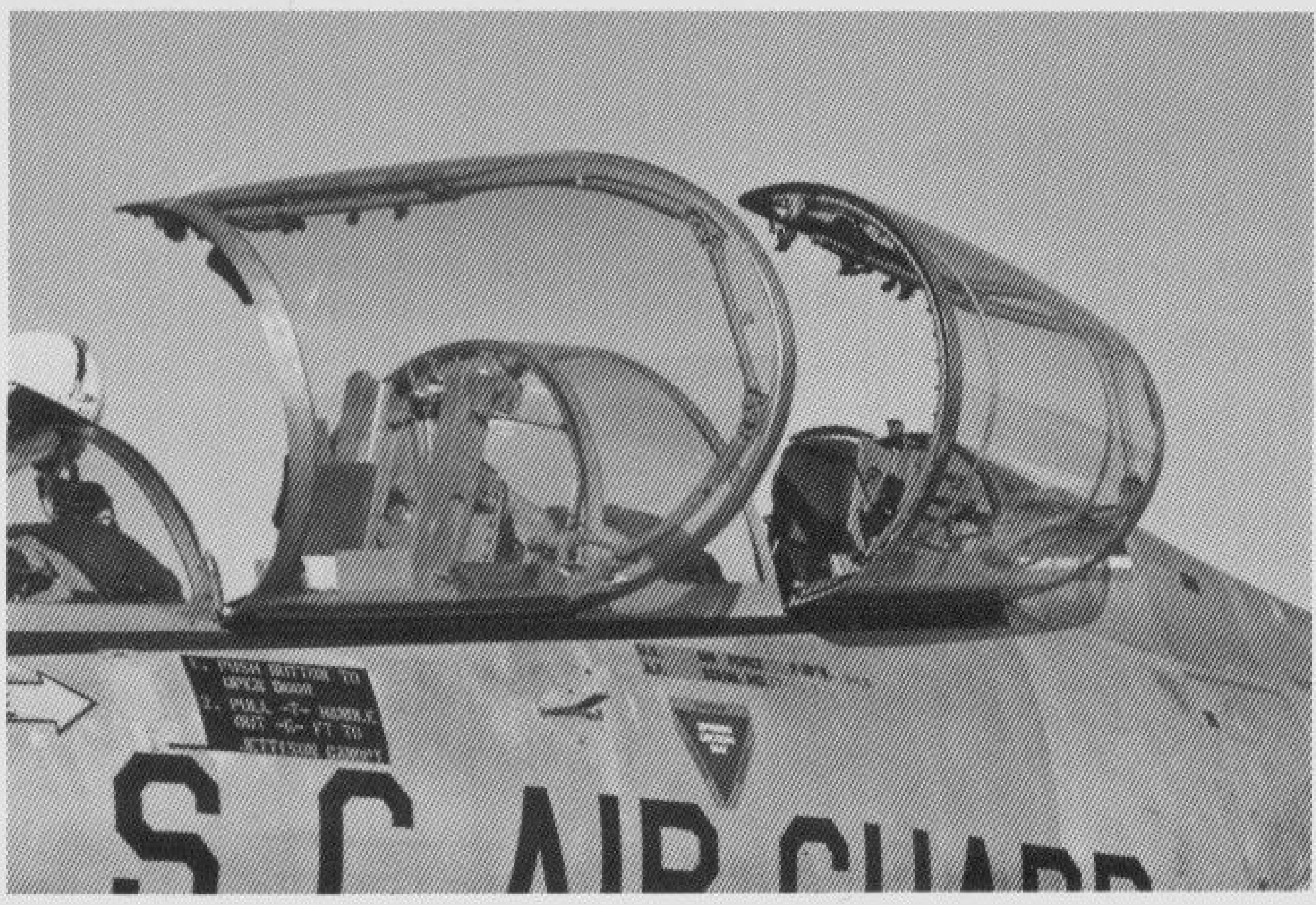


The typical F-104 boarding ladder is illustrated here, and the right side entry to the aircraft is being demonstrated.
(Taylor collection)

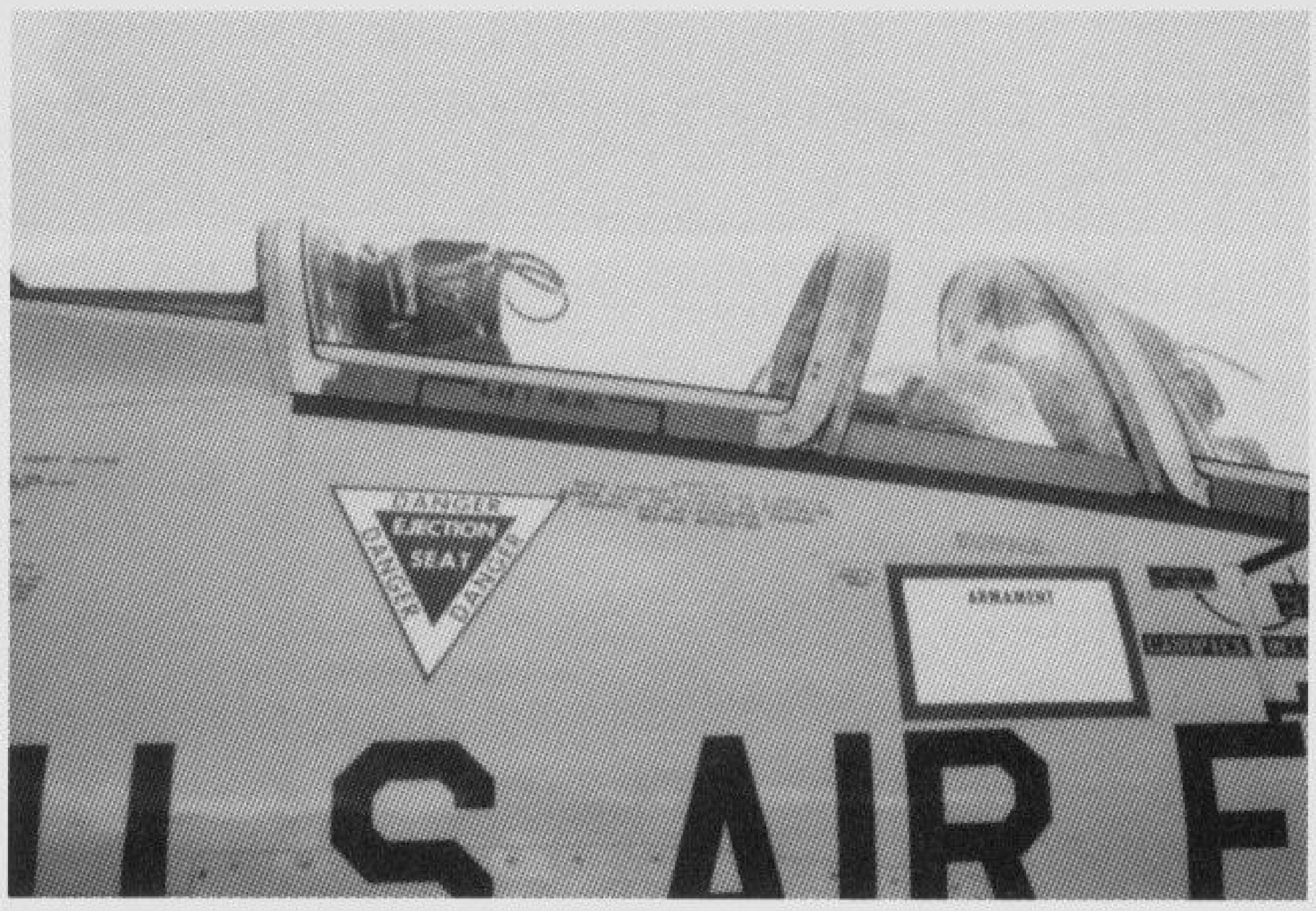




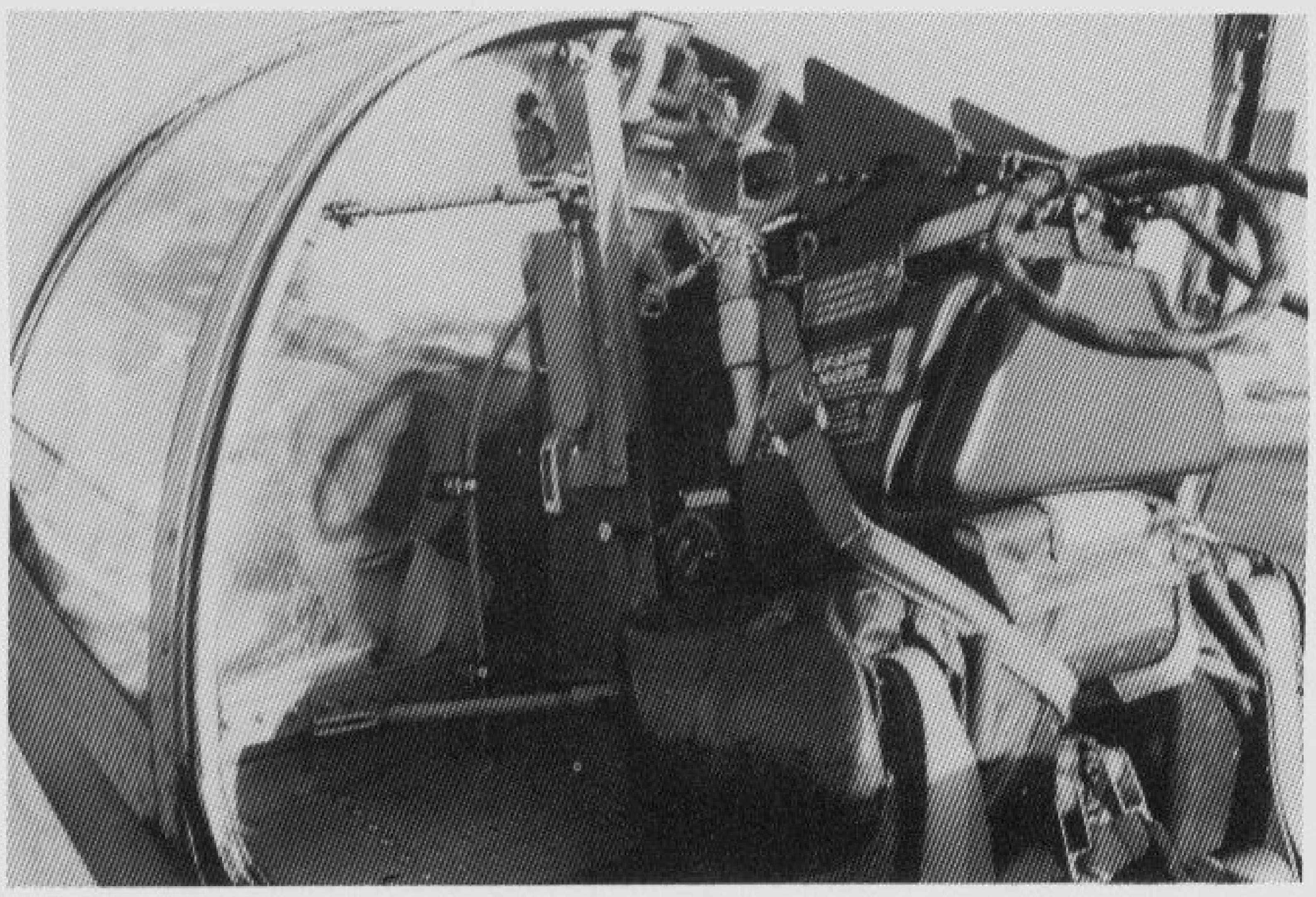
There were two different canopy arrangements used on two-seat versions of the Starfighter. The earlier arrangement is shown in the photo at left. A hinged portion of the canopy covered each cockpit, and there was only a single brace of metal framing between them. Other reference material has indicated that this was the F-104B style canopy, while the canopy at right was the F-104D canopy. This is not the case as evidenced by the photographs on pages 19, 20, 21, and elsewhere in this book. This arrangement was fitted on F-104Bs and initially to a number of F-104Ds. Some F-104Bs were retrofitted with the later canopy arrangement, but others served their entire life with the early design. At right is the later canopy initially fitted to some F-104Ds and to all foreign two-seat versions of the F-104. It had a larger area between the two hinged portions of the canopy, and this part of the canopy had two metal frames with a glassed-in area between them. *(Left Taylor collection, right author)*

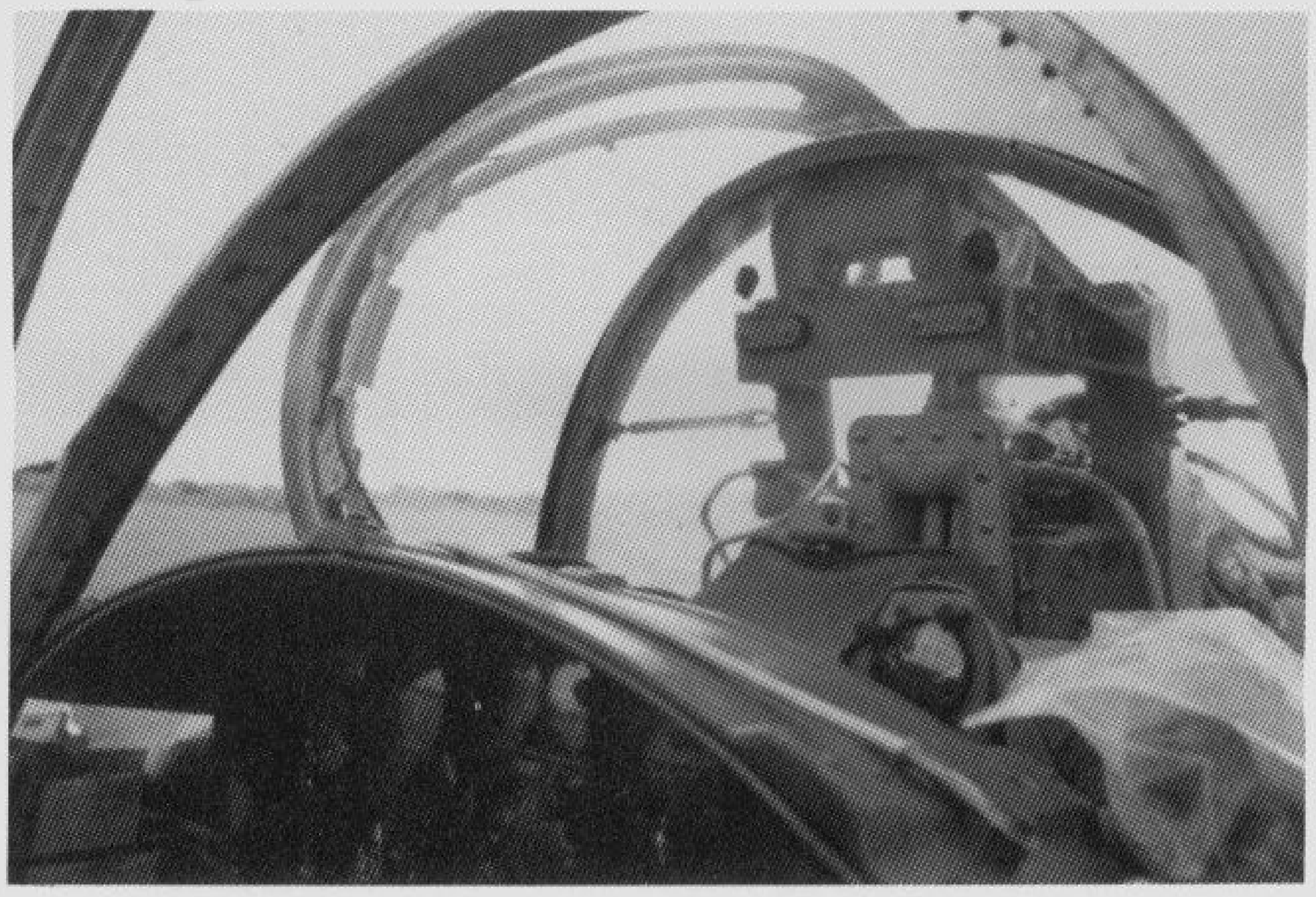


The two hinged portions of the later style two-seat canopy are seen in the open position and from the left side in this view. *(Taylor)*



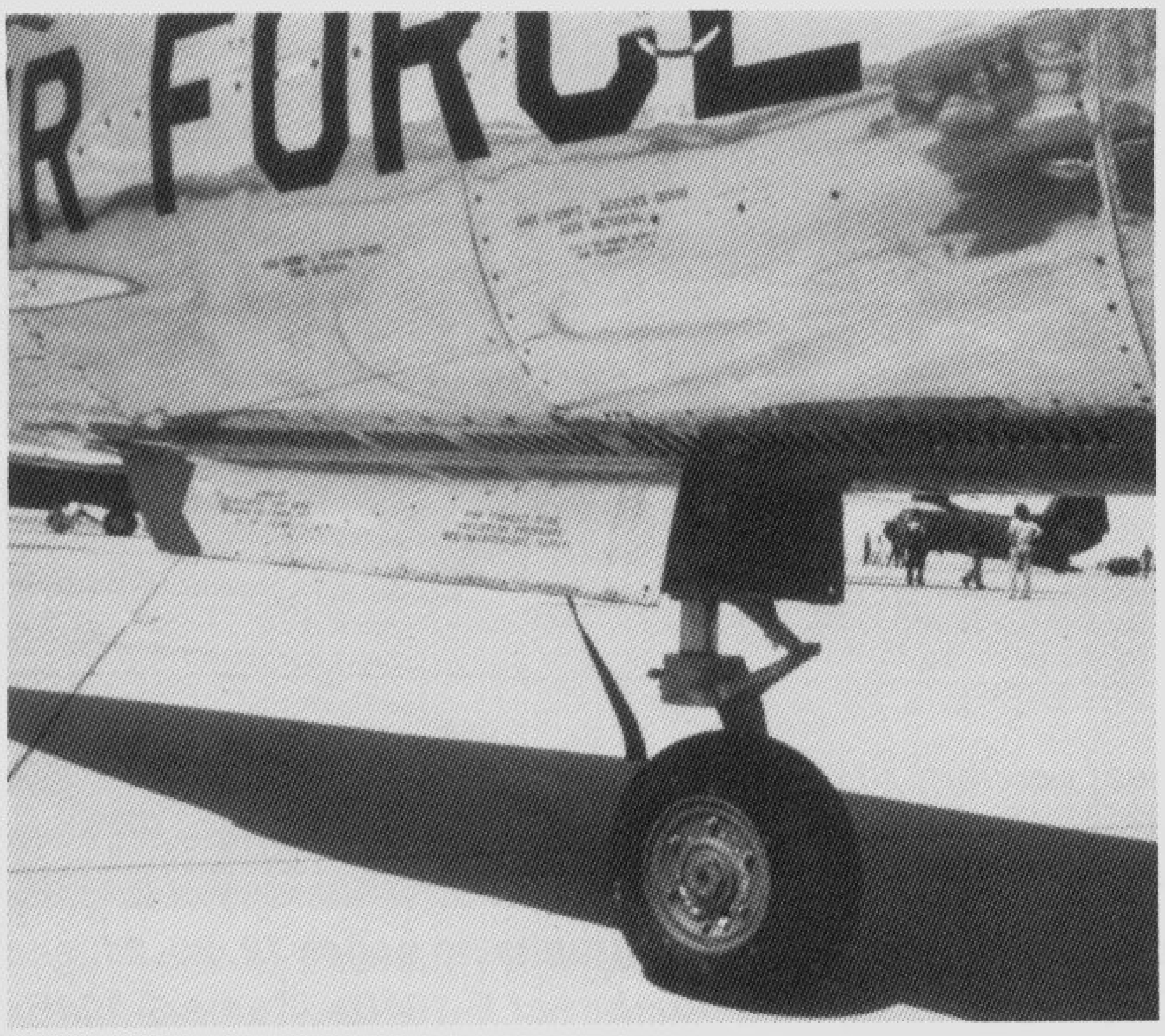
The center section and aft hinged canopy section of the later style two-seat canopy are illustrated from the right in this photograph.



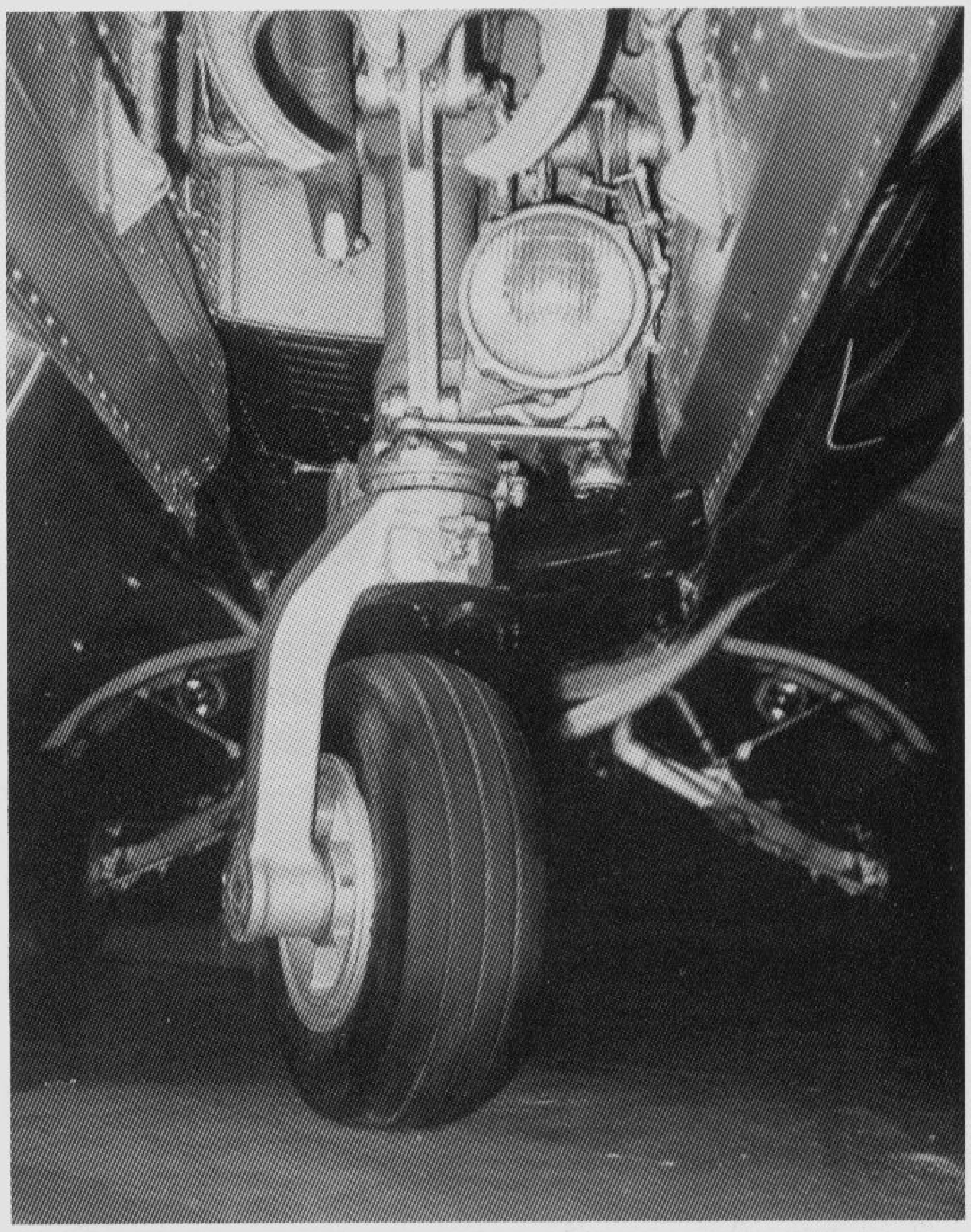


These two views show the framing of the center section for the later two-seat canopy from the inside. The photo at left was taken from the front and looks aft on the right side. Note that there is a plexiglass sheet positioned vertically inside the center section that protects the rear seat pilot from the wind blast in the event the forward canopy is lost. At right is the framing as viewed from the aft cockpit looking forward.

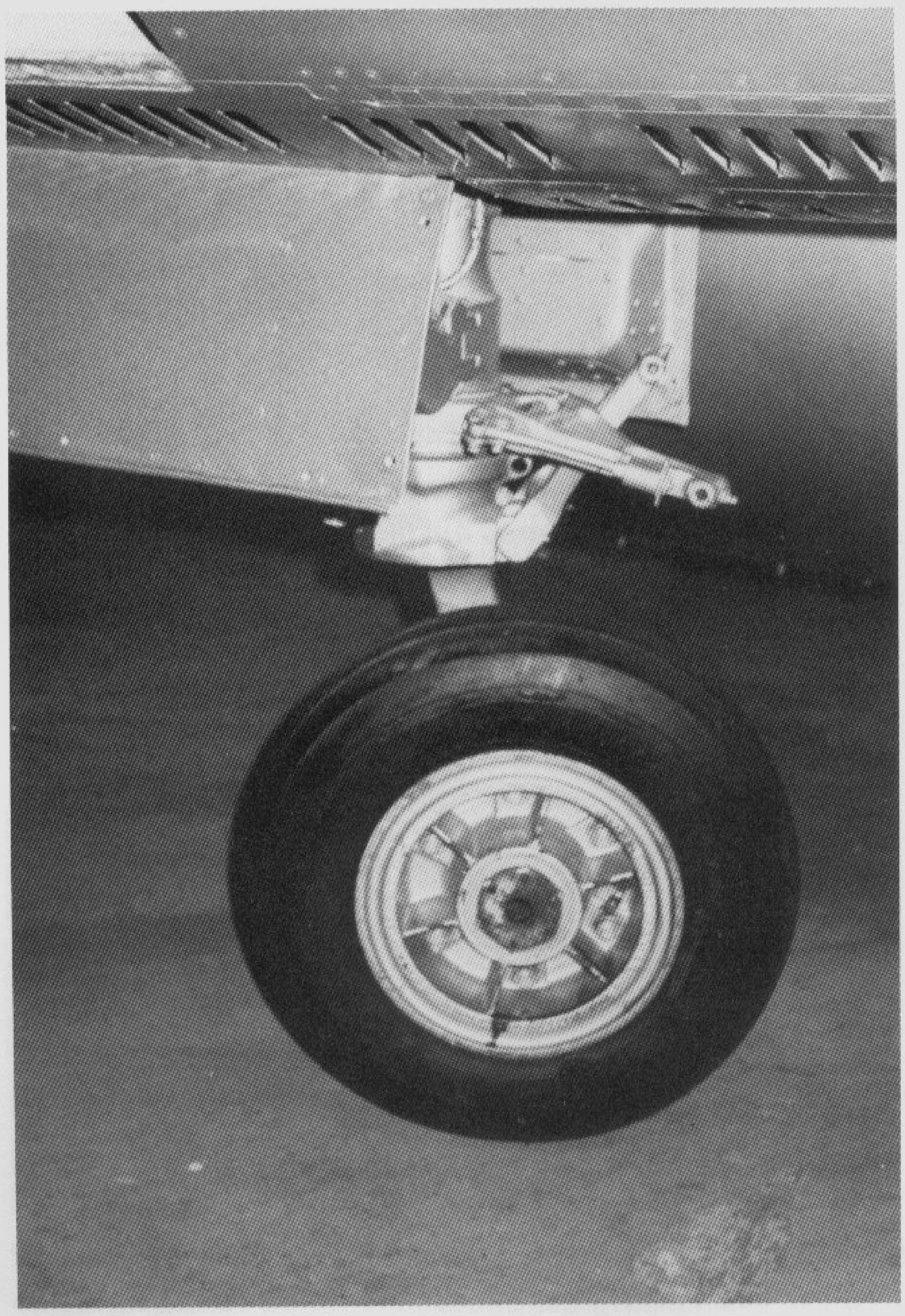
NOSE LANDING GEAR

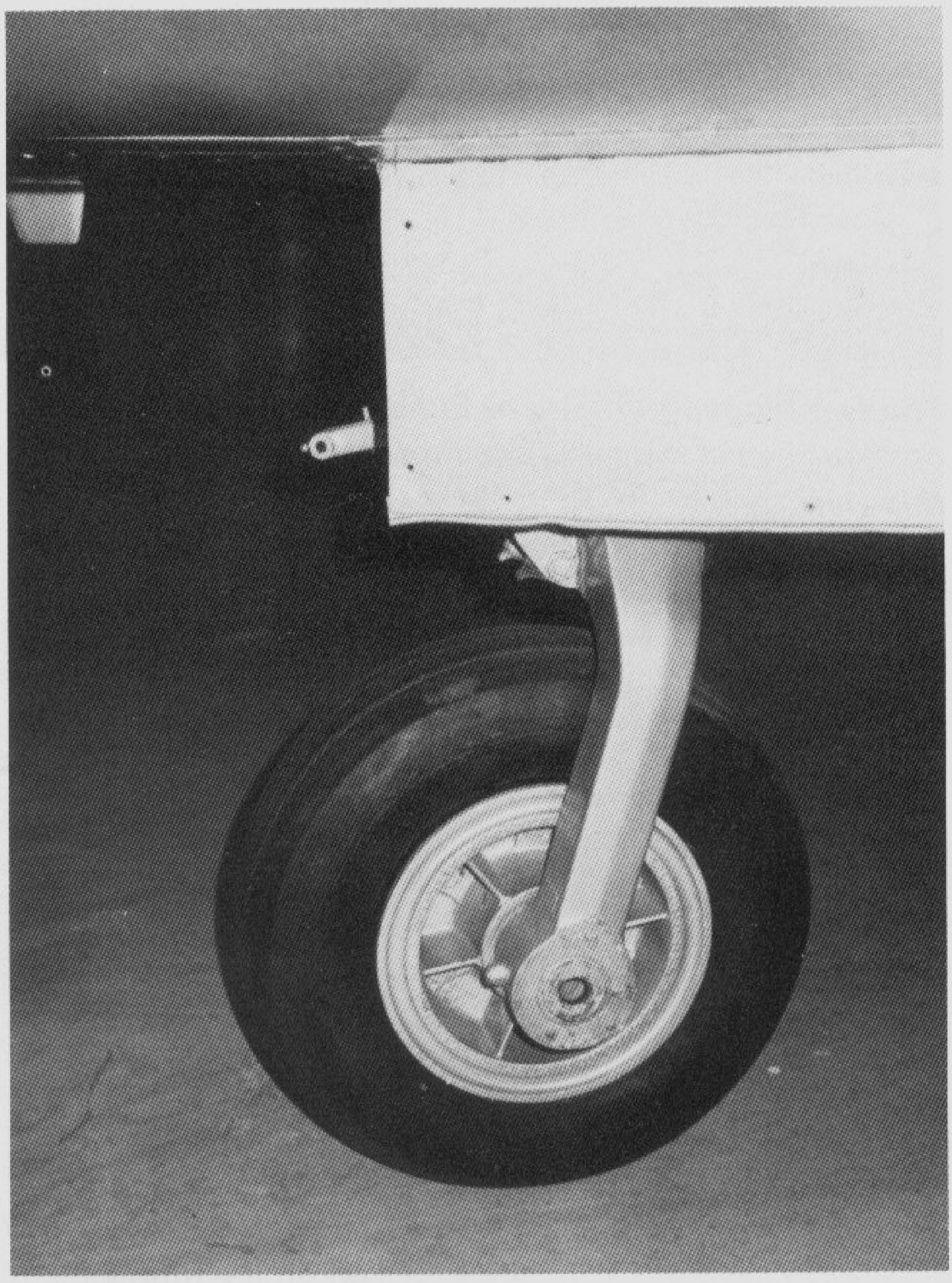


With the exception of the two XF-104s, single-seat versions of the Starfighter had nose gear with the strut and wheel mounted at the aft end of the wheel well as shown here. The nose wheel illustrated in this photograph is the one most commonly seen on Starfighters. This view was taken from the left side of the aircraft and slightly behind the nose gear.

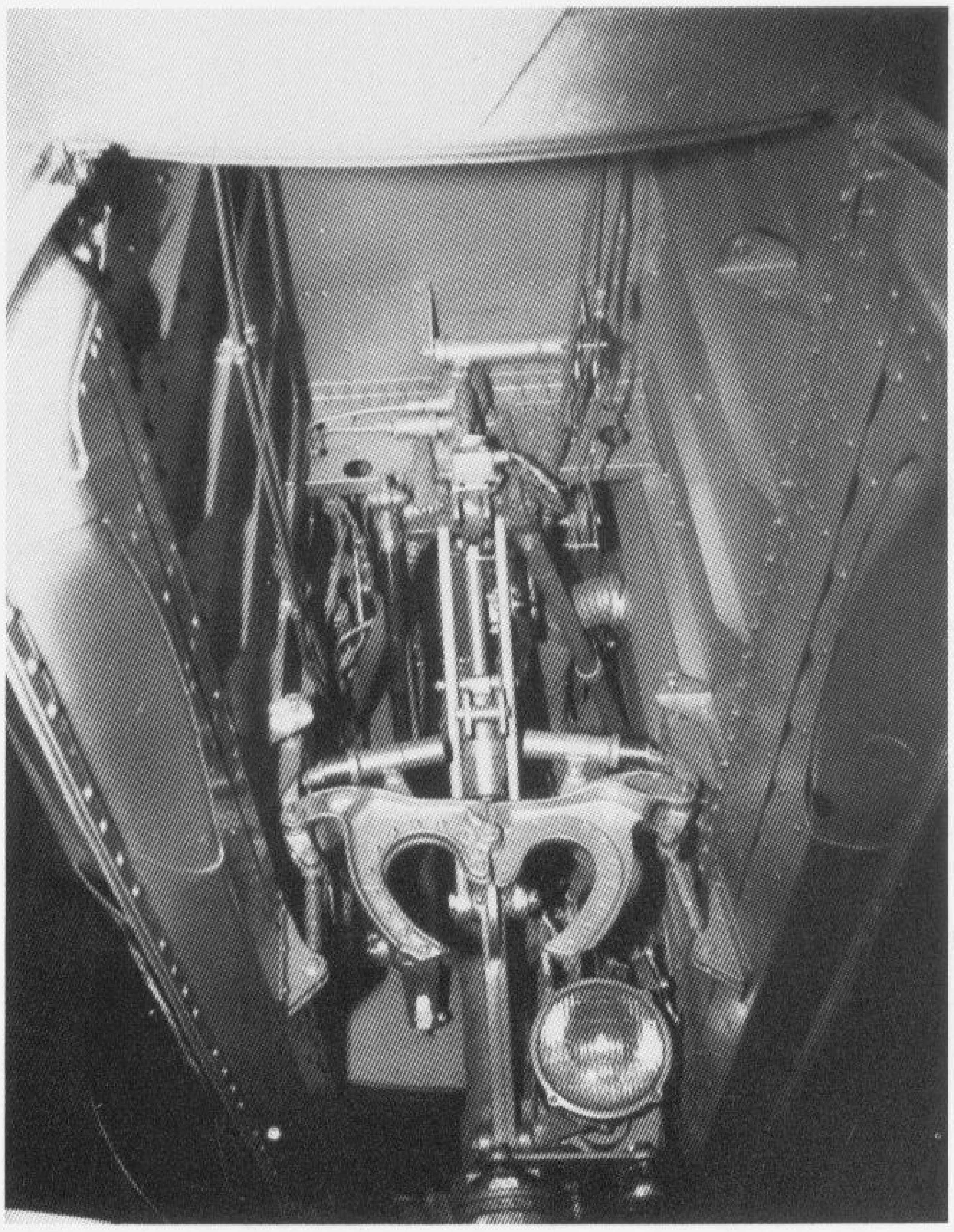


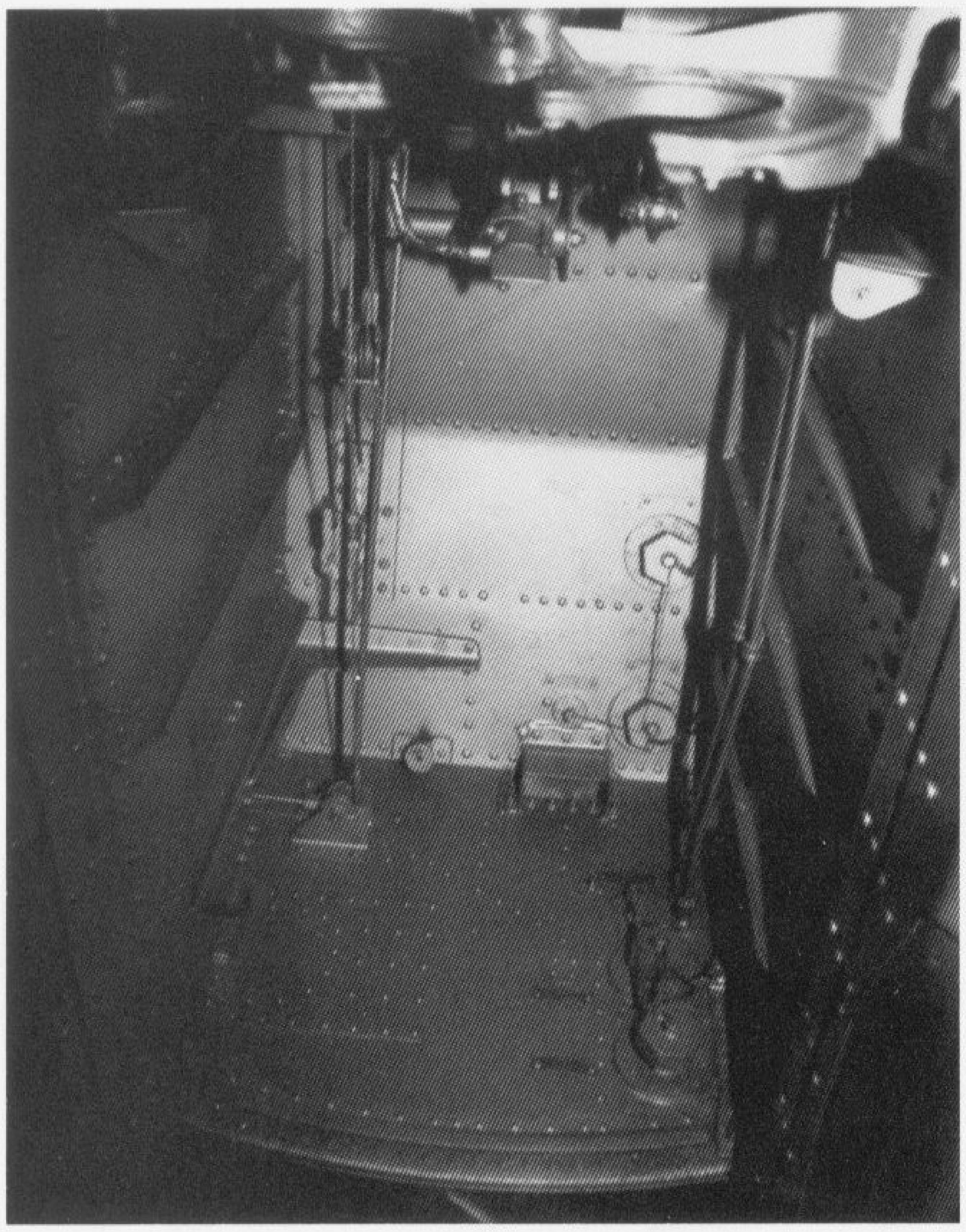
The nose gear strut and taxi light are revealed in the close-up.



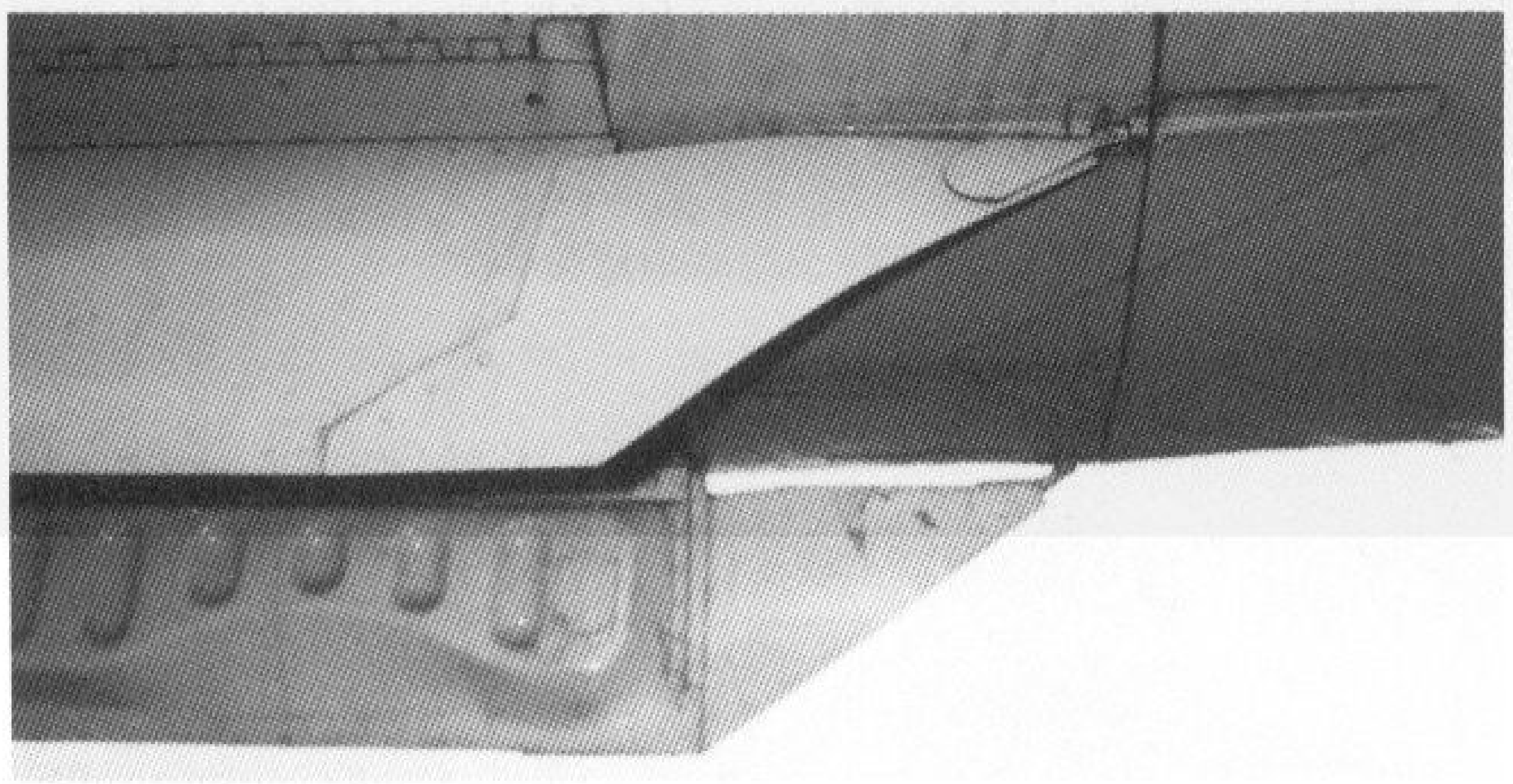


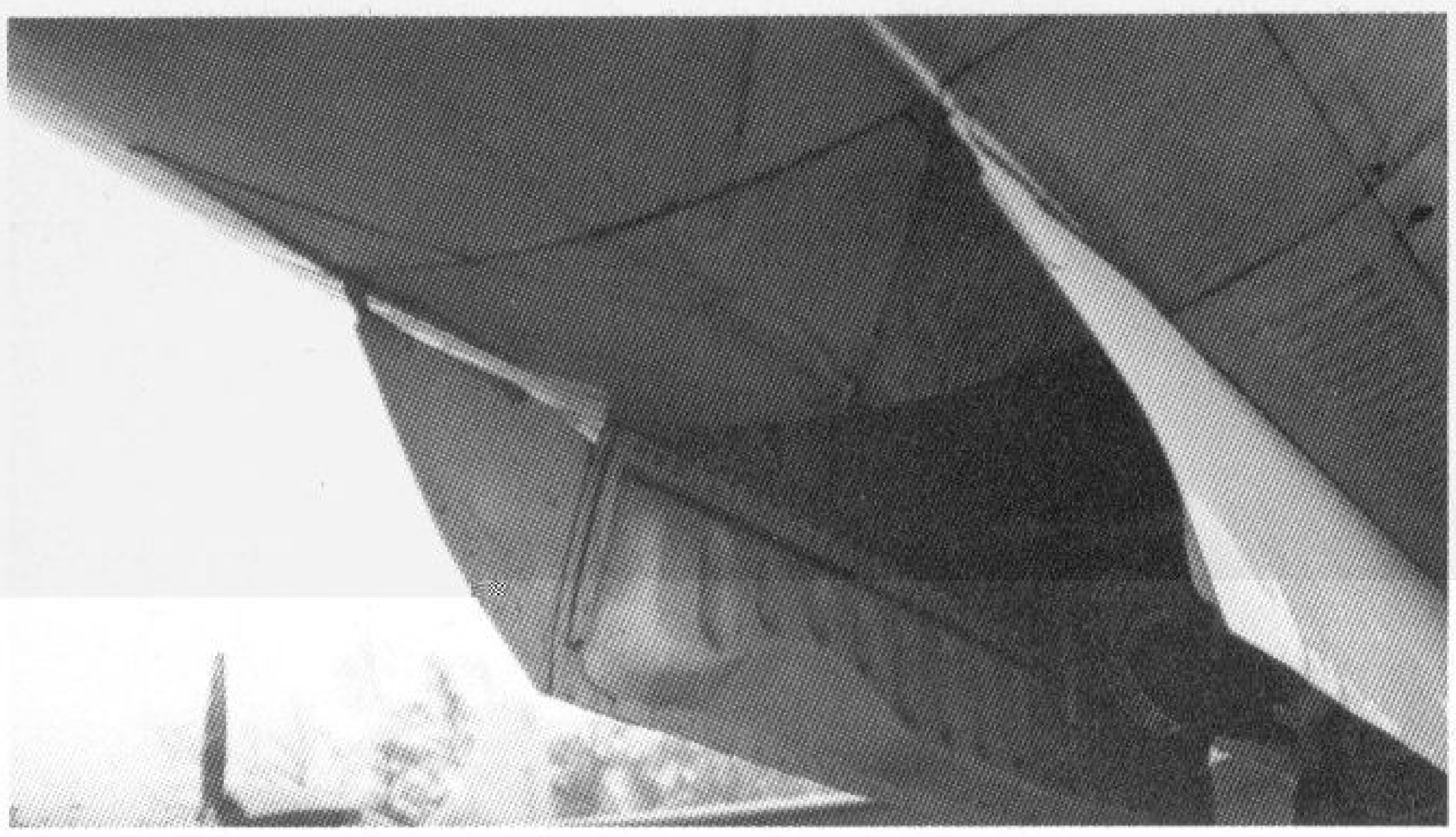
Left and right side views of the nose gear wheel and tire are provided in these two photographs. The wheel is a different design than that seen in the top left photo.



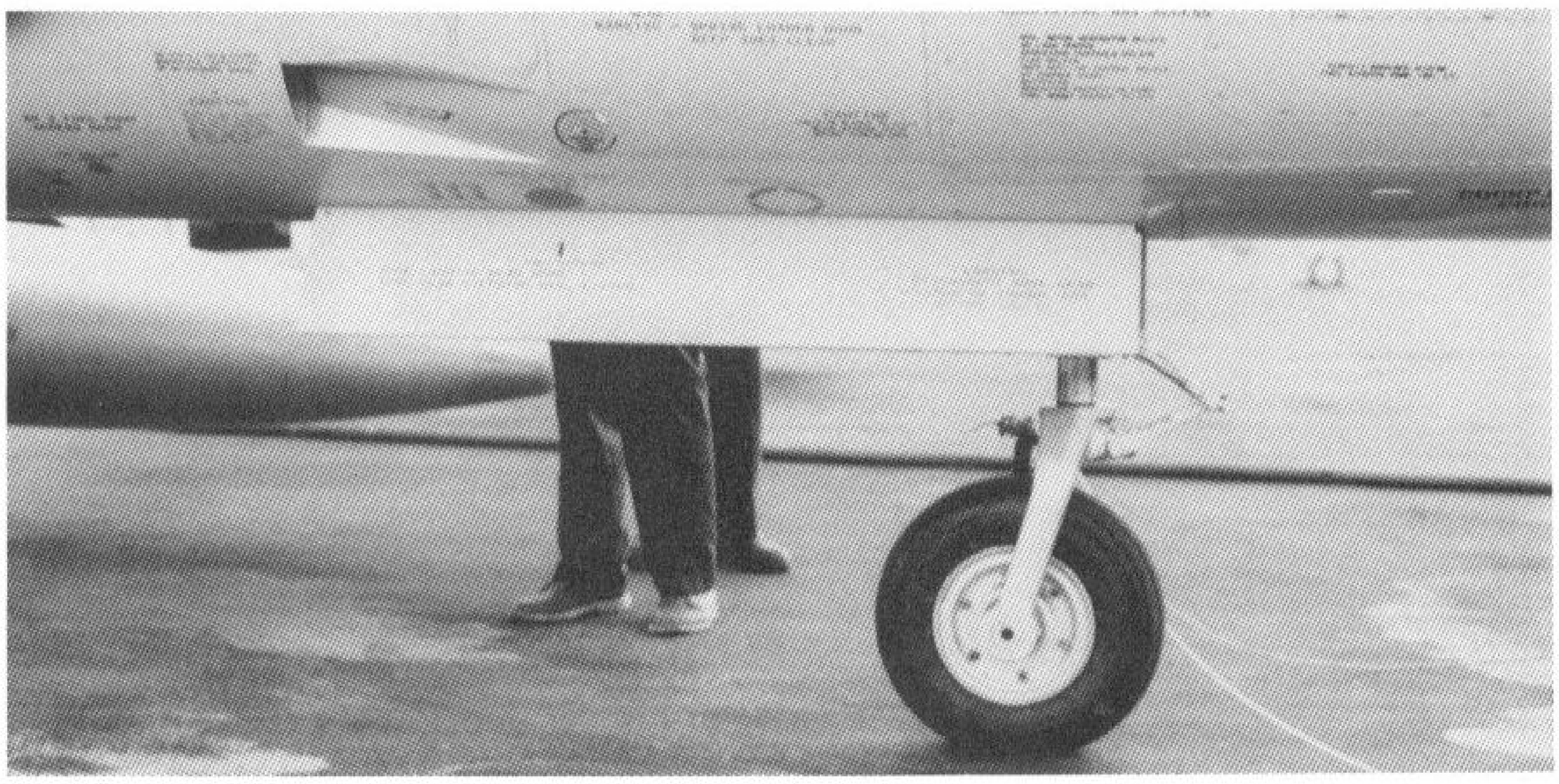


Details of the nose gear well are shown in these two photographs. The view at left looks aft into the well, and at right is the forward end of the nose gear well.



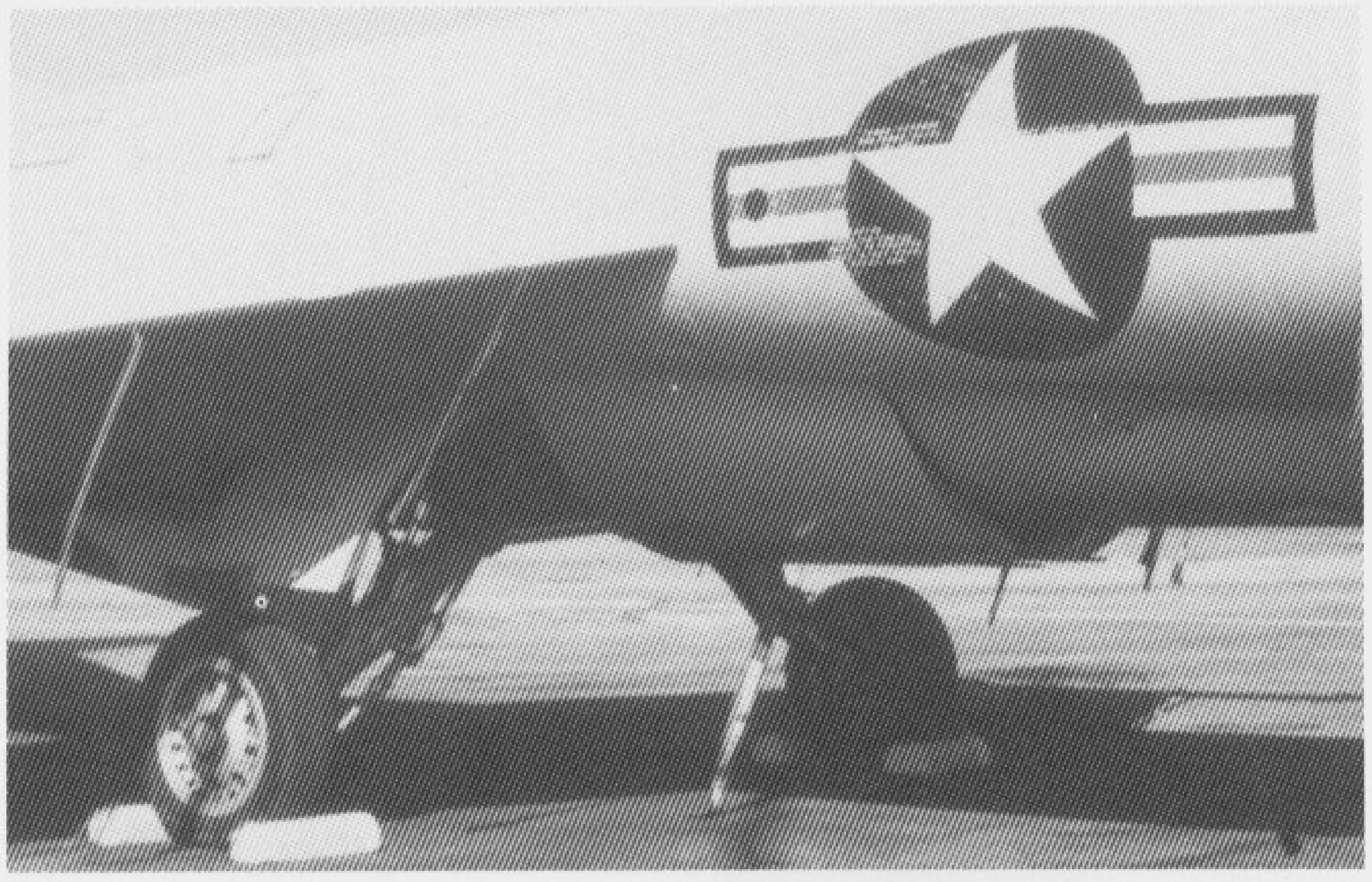


Although the nose gear well was rectangular in shape, the doors on single-seat versions usually had angled pieces of sheet metal at their forward ends. These fit into small indentions in the underside of the fuselage when the doors closed. Details of these forward extensions on the nose gear doors are shown in these two views, as are their hinges and the indentions or recessed areas just forward of the nose gear well. It should be noted that these extensions were not fitted to all aircraft.

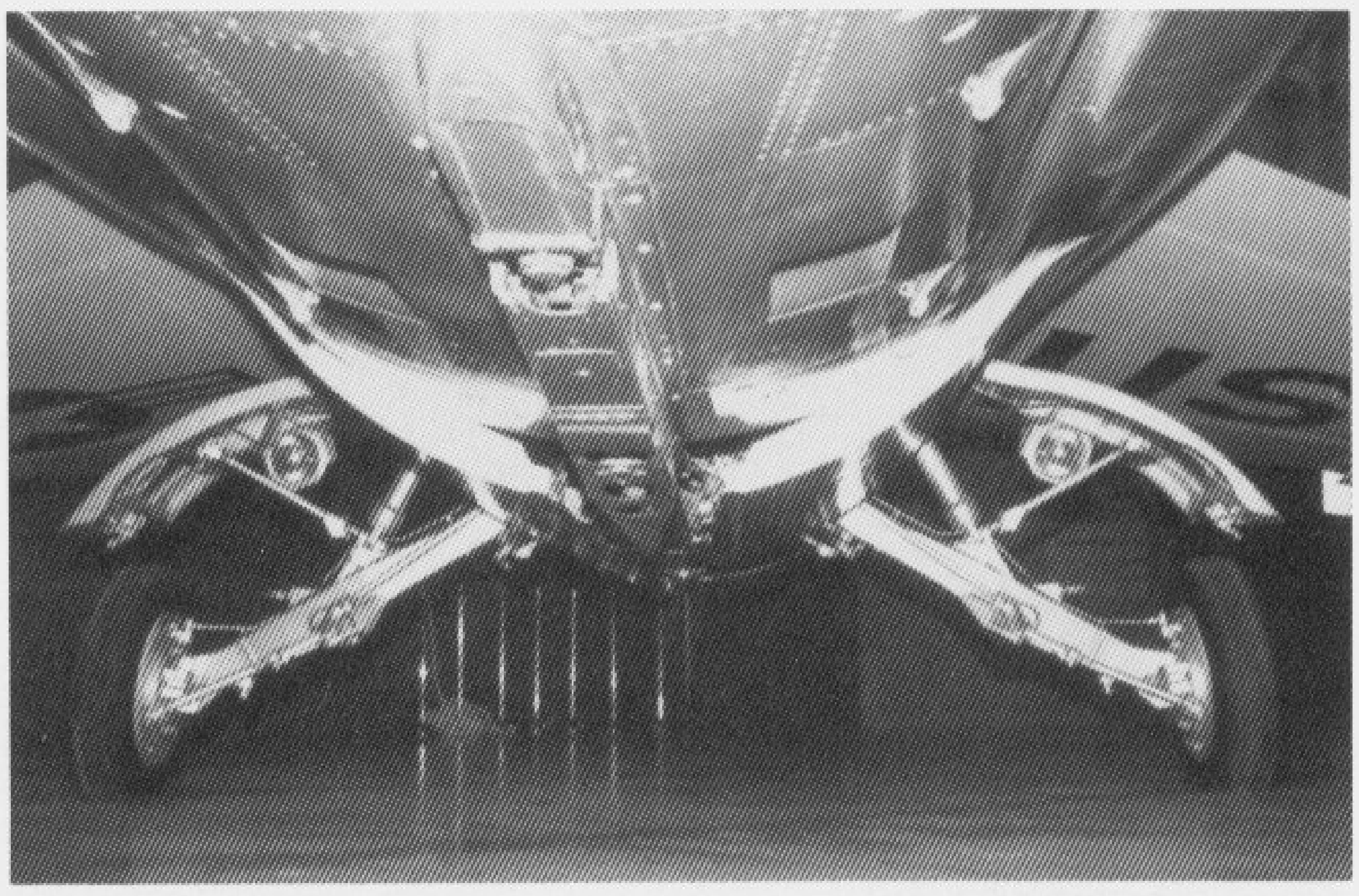


Two seat versions had rectangular-shaped doors, and the nose gear strut was located at the forward end of the well as shown here. Forward is to the right in the photograph. Details of the more common nose gear wheel are again shown in this photograph.

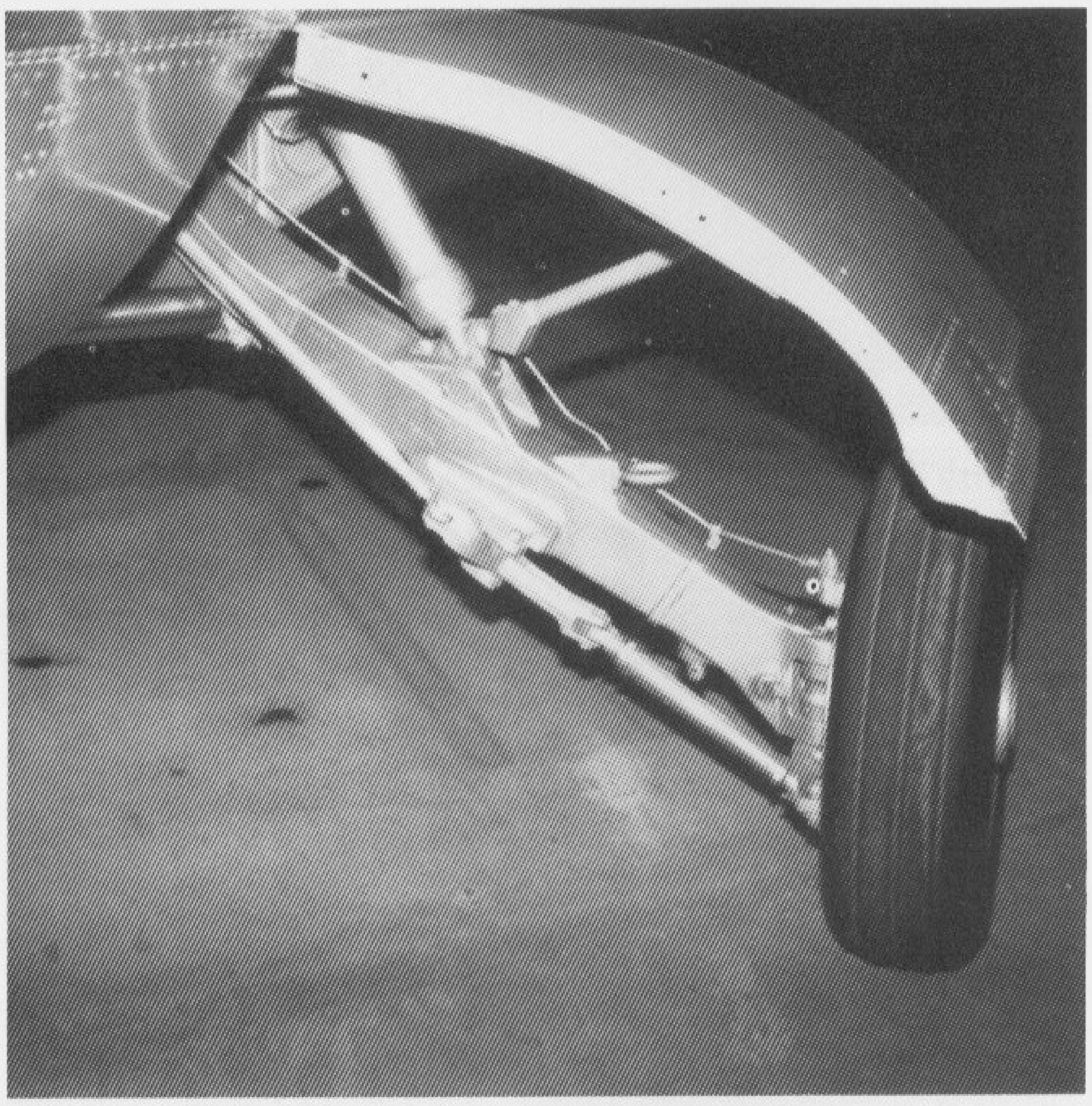
MAIN LANDING GEAR



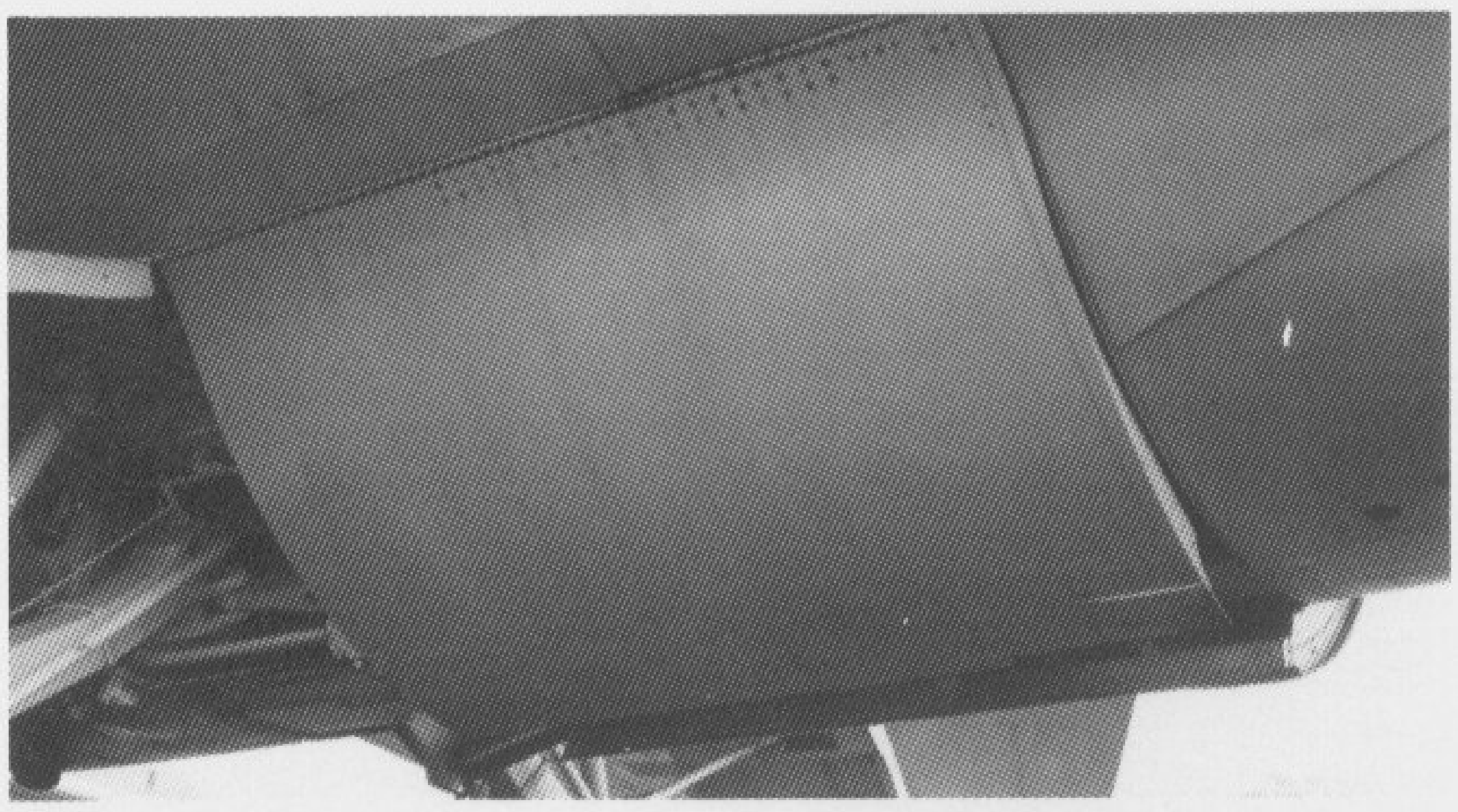
An overall view of the main gear as viewed from the right is provided by this photo. Note how the larger forward doors are in a partially open position when the aircraft is on the ground. (Munkasy)



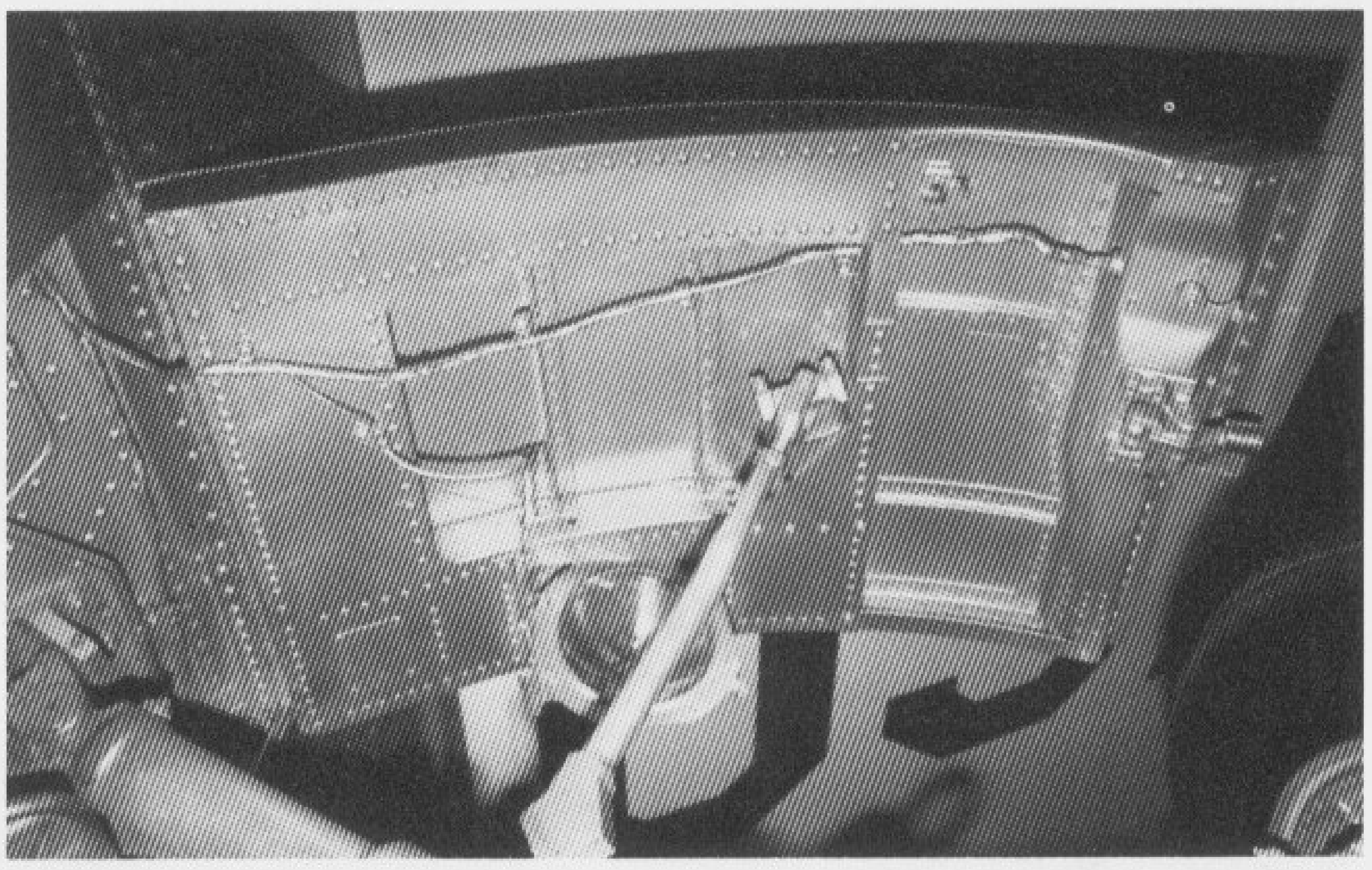
The main gear on an F-104C is shown from the front in this photograph. The angle of the aft doors in the open position is clearly shown, as are the landing and taxi lights located on each door.



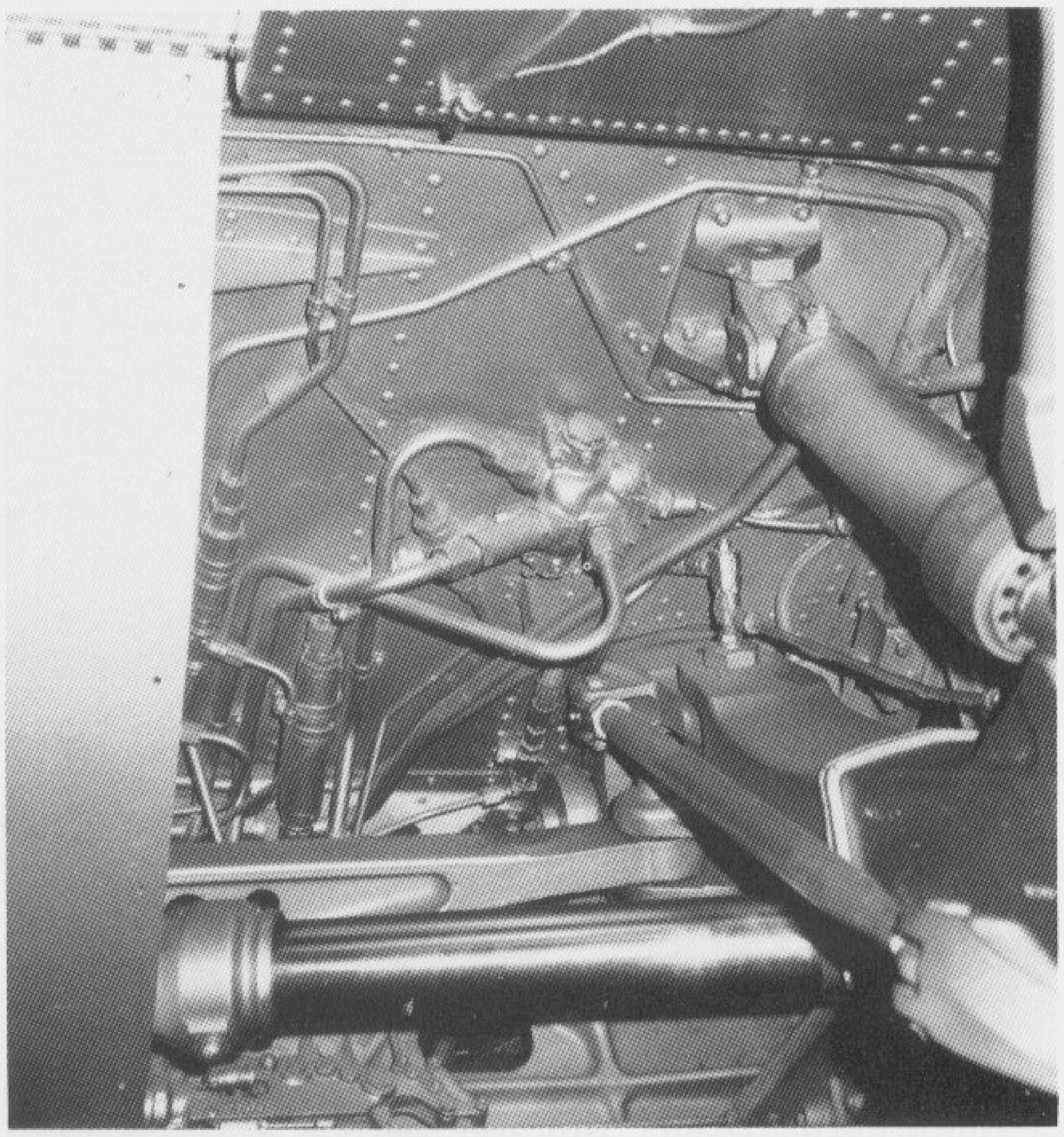
This is an overall view of the left main gear as viewed from the front.



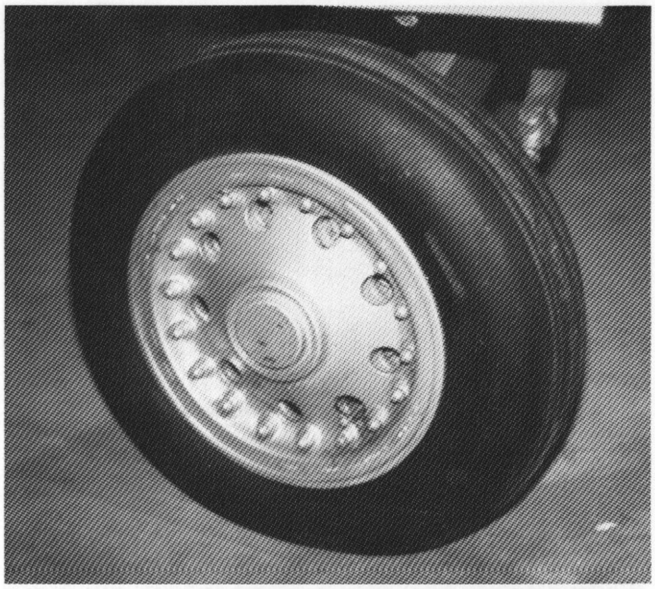
This close-up shows the larger, forward, main gear doors in their usual position when the gear was lowered. These doors were not bulged as they were on the fighter-bomber versions of the F-104 that were built for foreign use. (See page 52.)

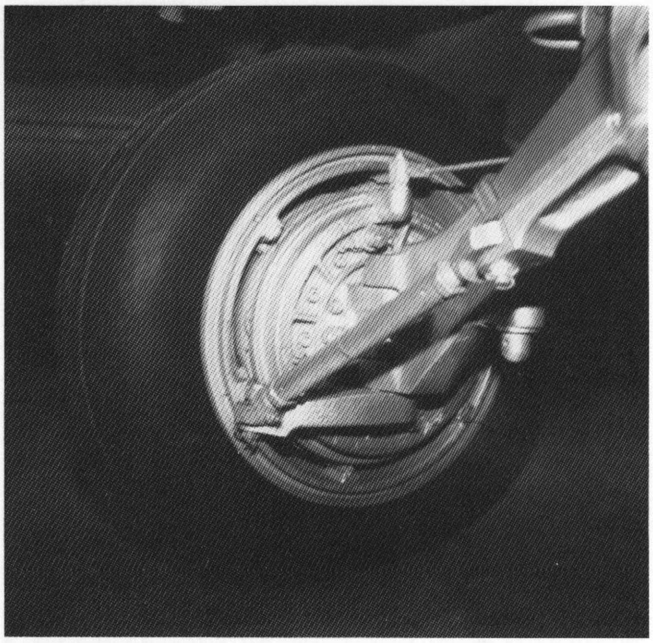


Details of the inside of the aft door for the left main gear well are illustrated here. The well, struts, and insides of the doors were usually painted aluminum. Note the brace between the main strut and the door.



The left side of the main gear well is shown here.

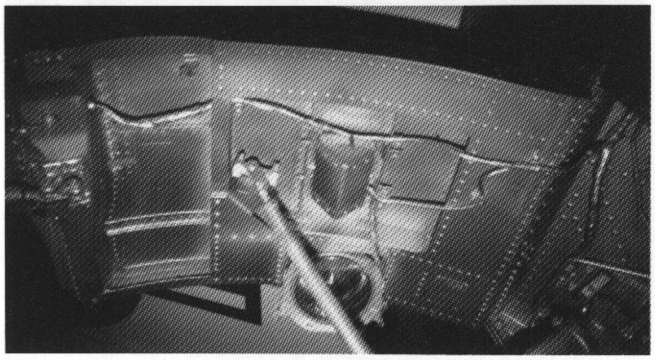


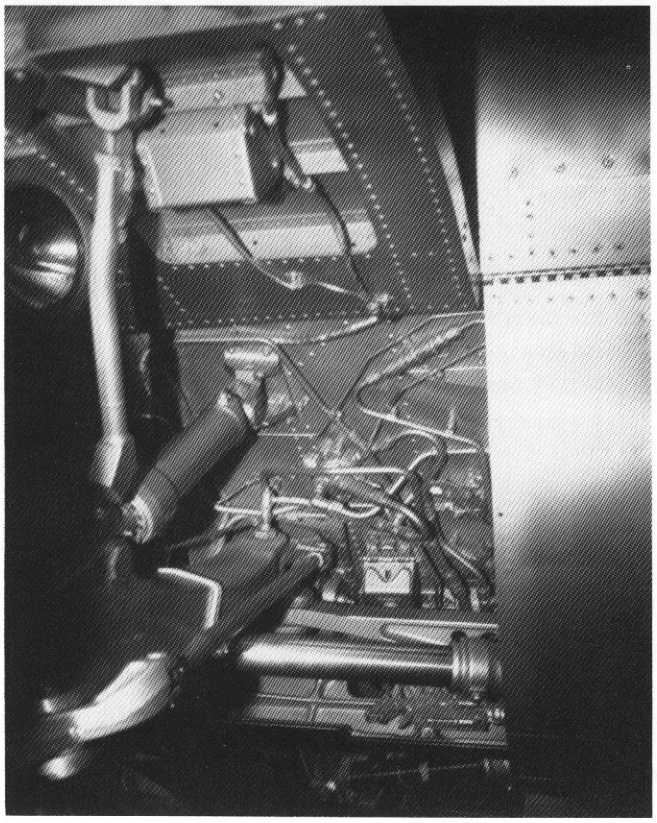


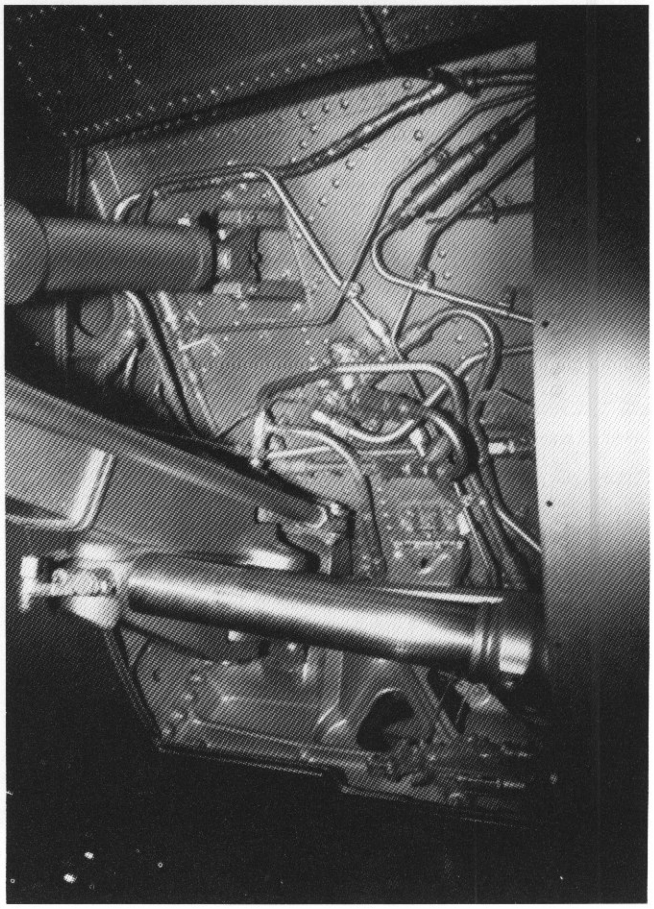
Above left and right: Details of the main gear wheels as used on USAF Starfighters are illustrated in these two photographs.

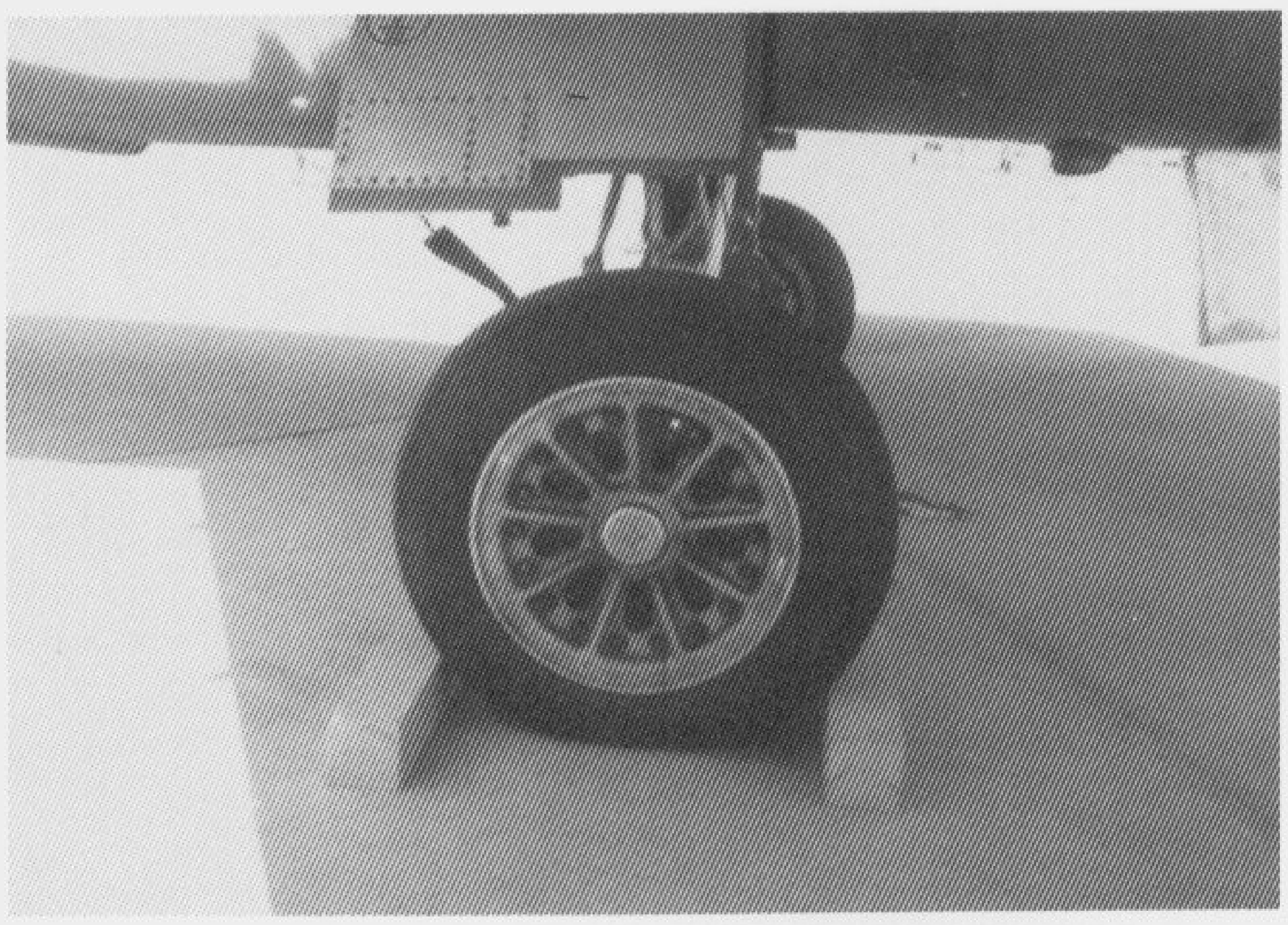
Left: The inside of the aft door for the right main gear well is shown here.

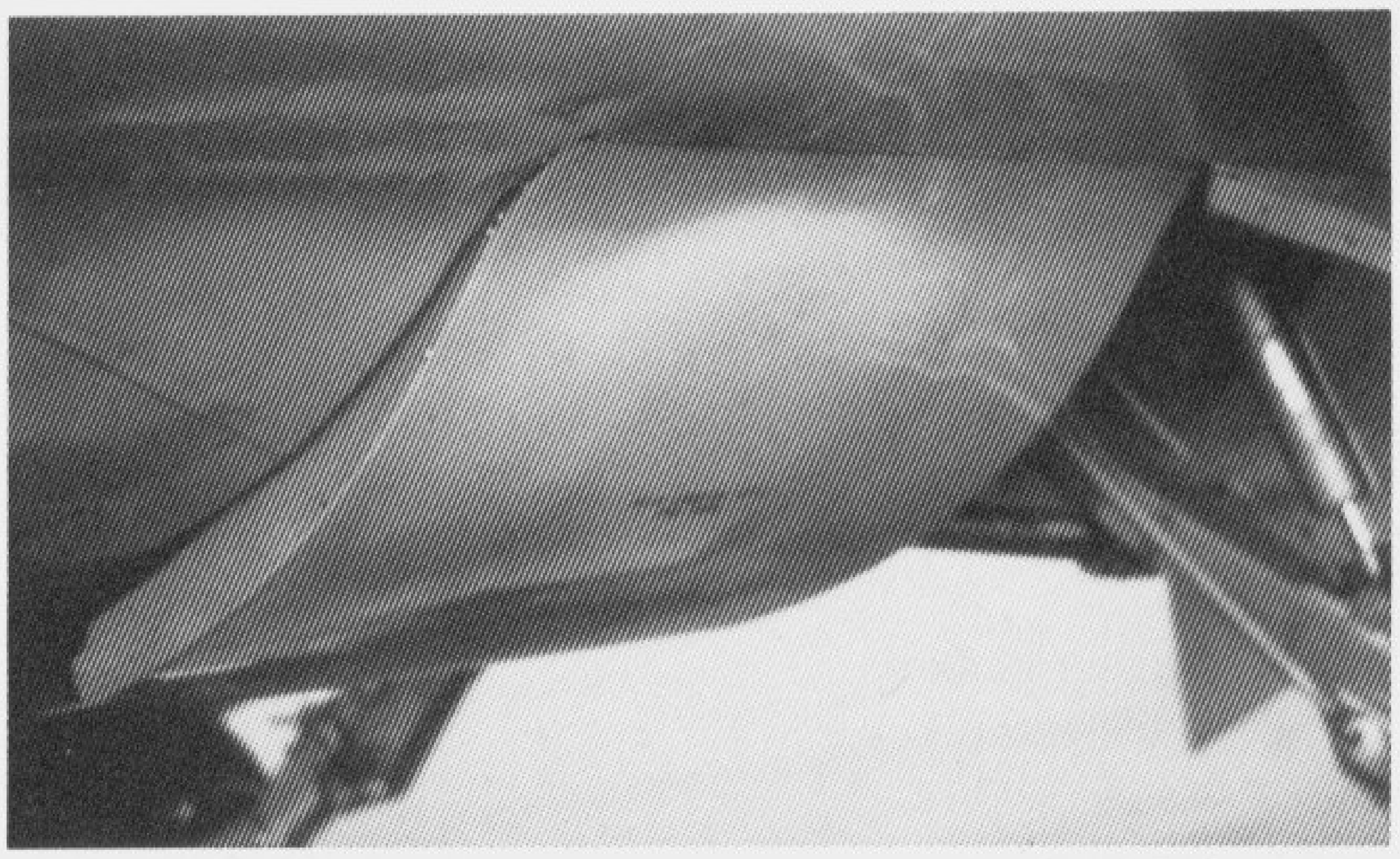
Below left and right: These two views provide a look at the details in the right side of the main gear well.









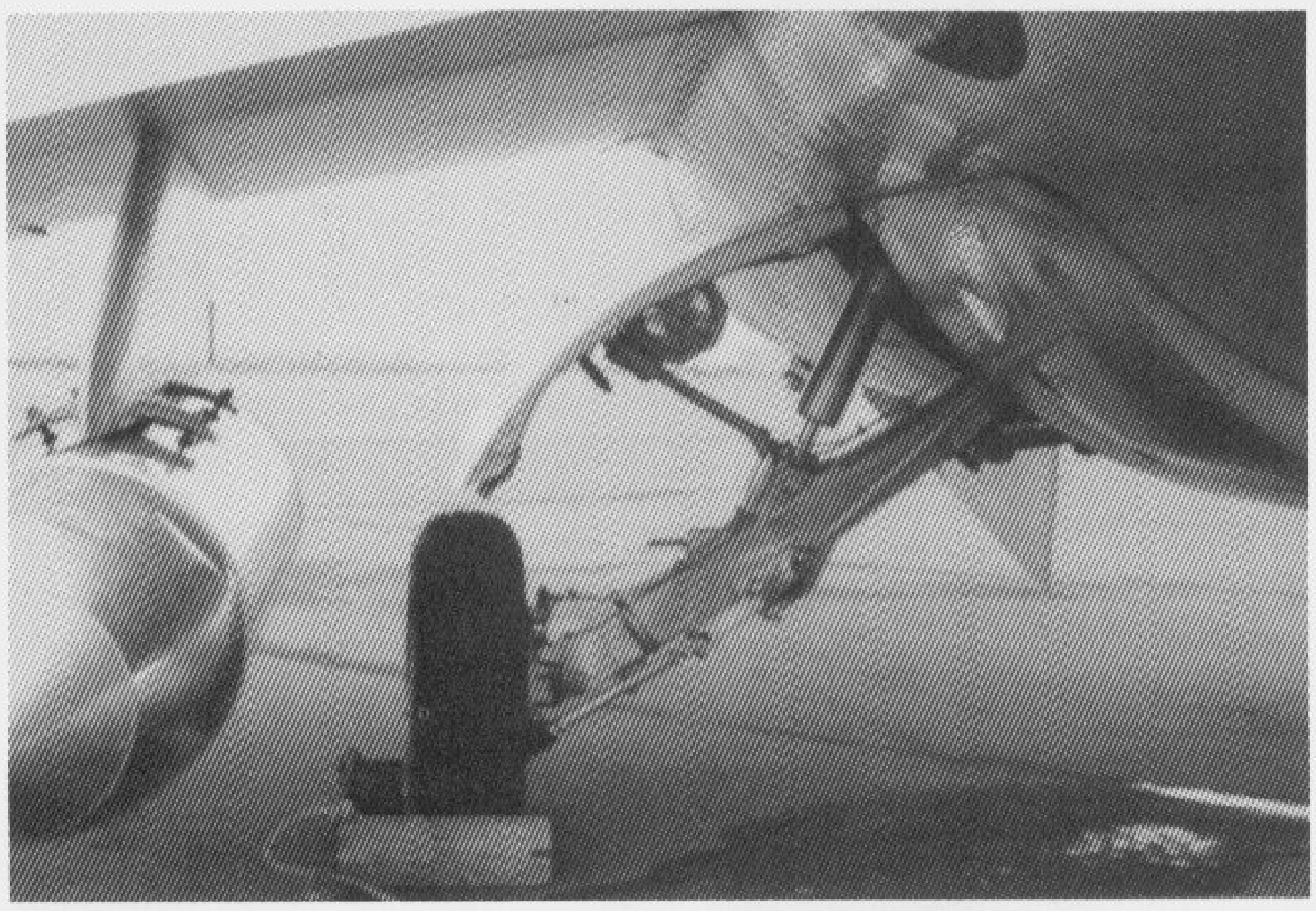


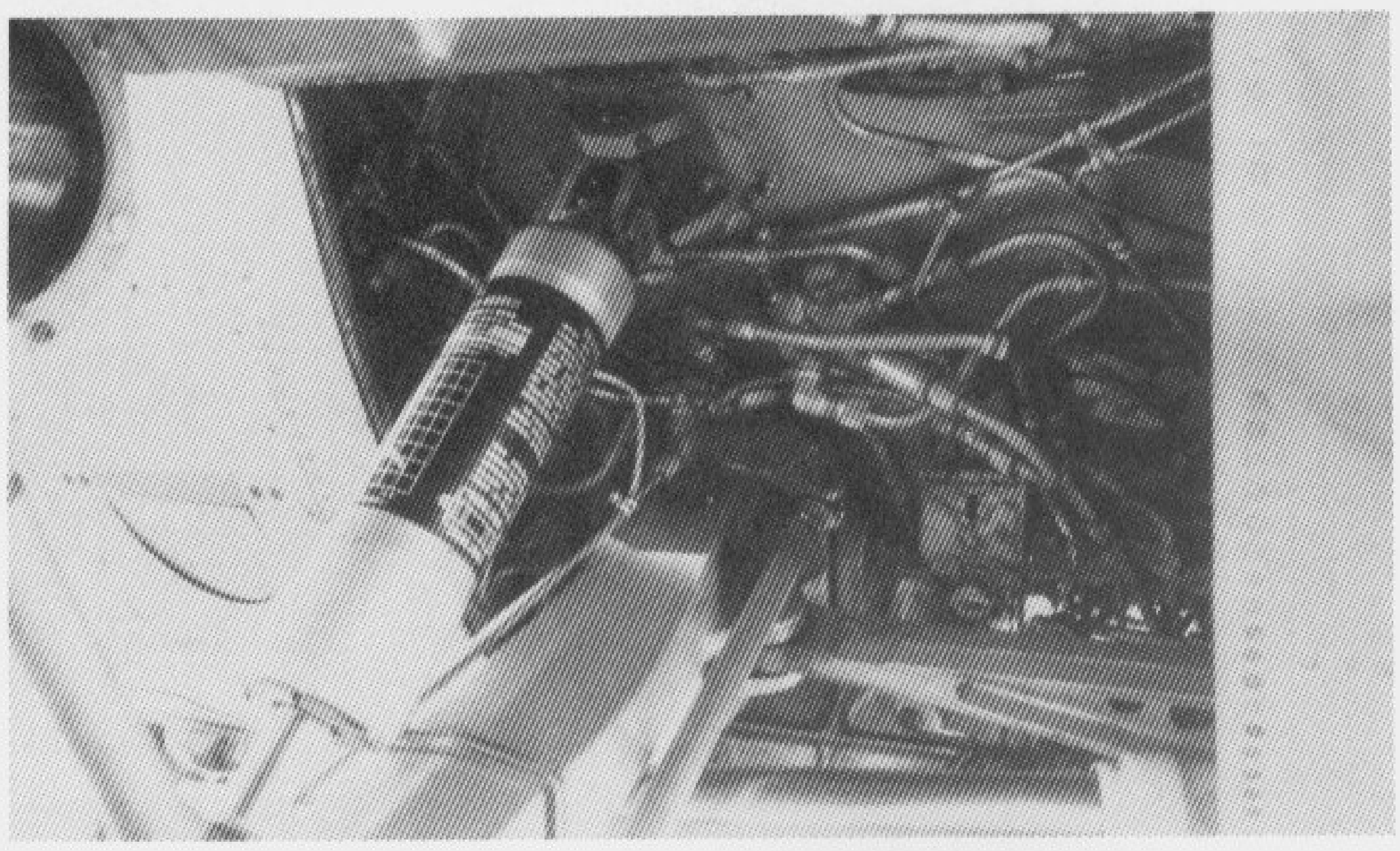
Above left: Since the fighter-bomber versions of the Starfighter used by foreign nations were heavier than the U.S. variants, the main landing gear was stronger. Thicker tires were used, and the wheel was a spoked design rather than the holed wheel shown on the previous page.

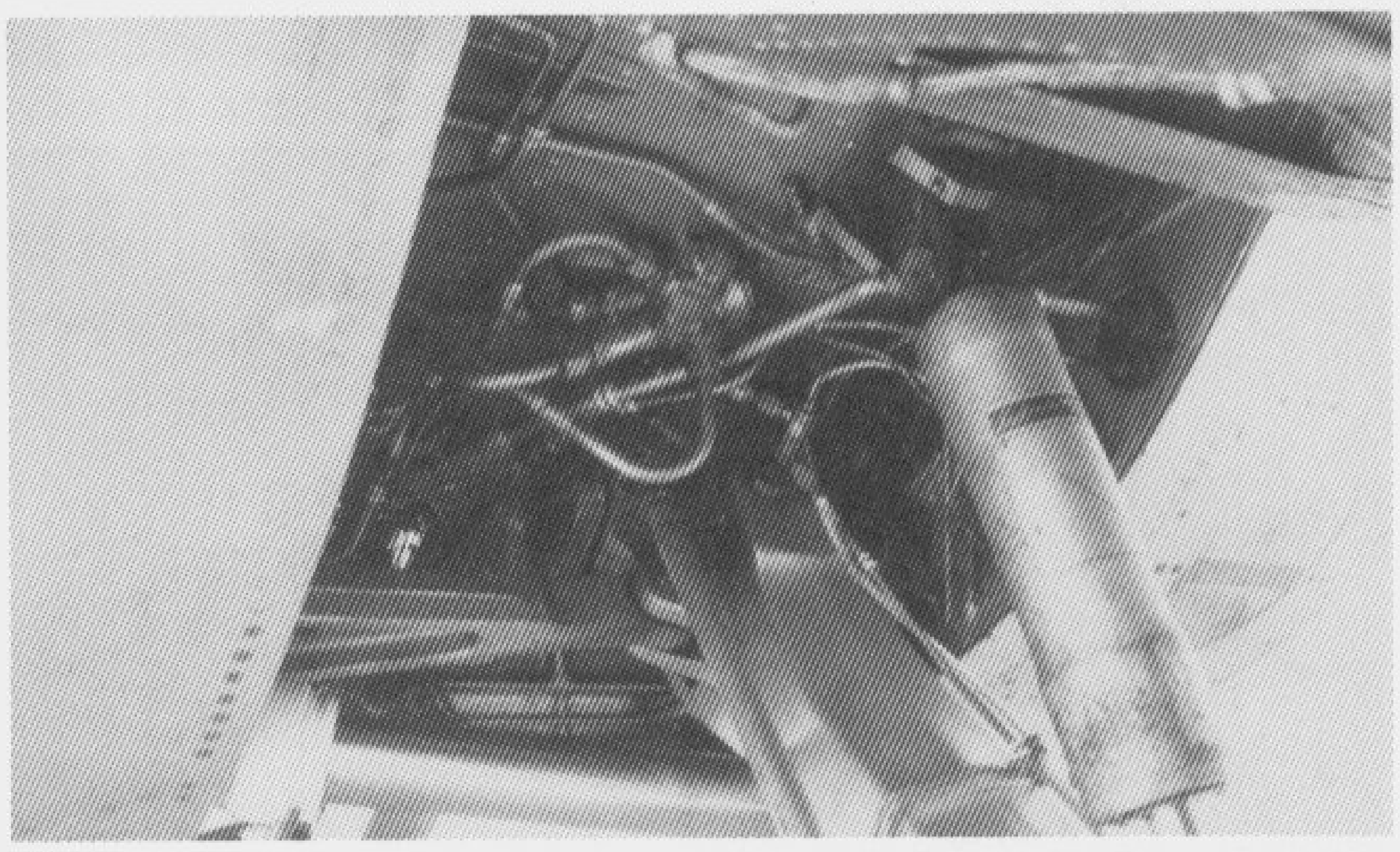
Above: To make room for the thicker wheels and tires, the forward main gear doors were slightly bulged as illustrated in this photograph. The bulge is easiest to see at the top of the door near the hinge, and it is blended smoothly into the door.

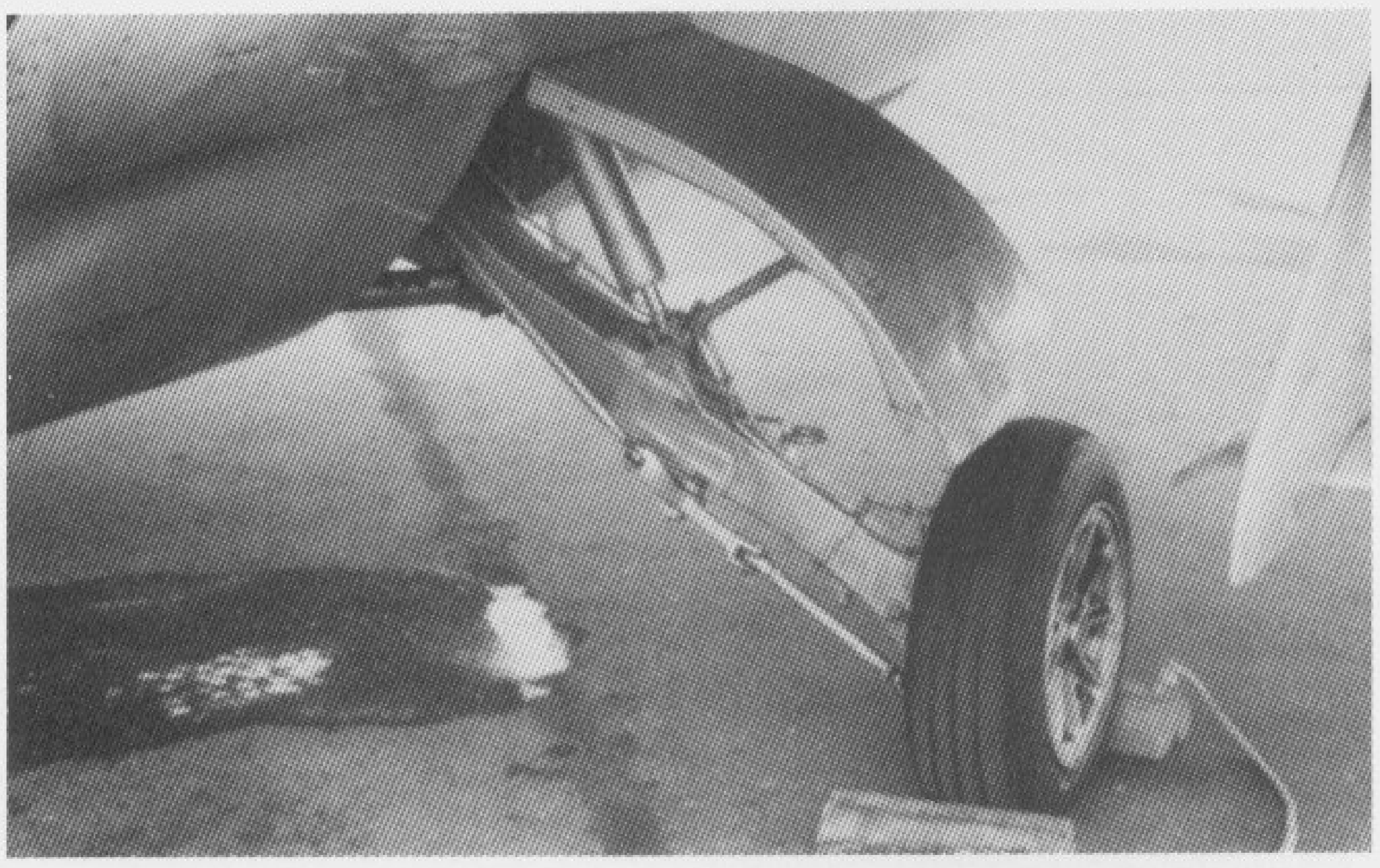
Left: The right main gear on the same TF-104G is shown here.

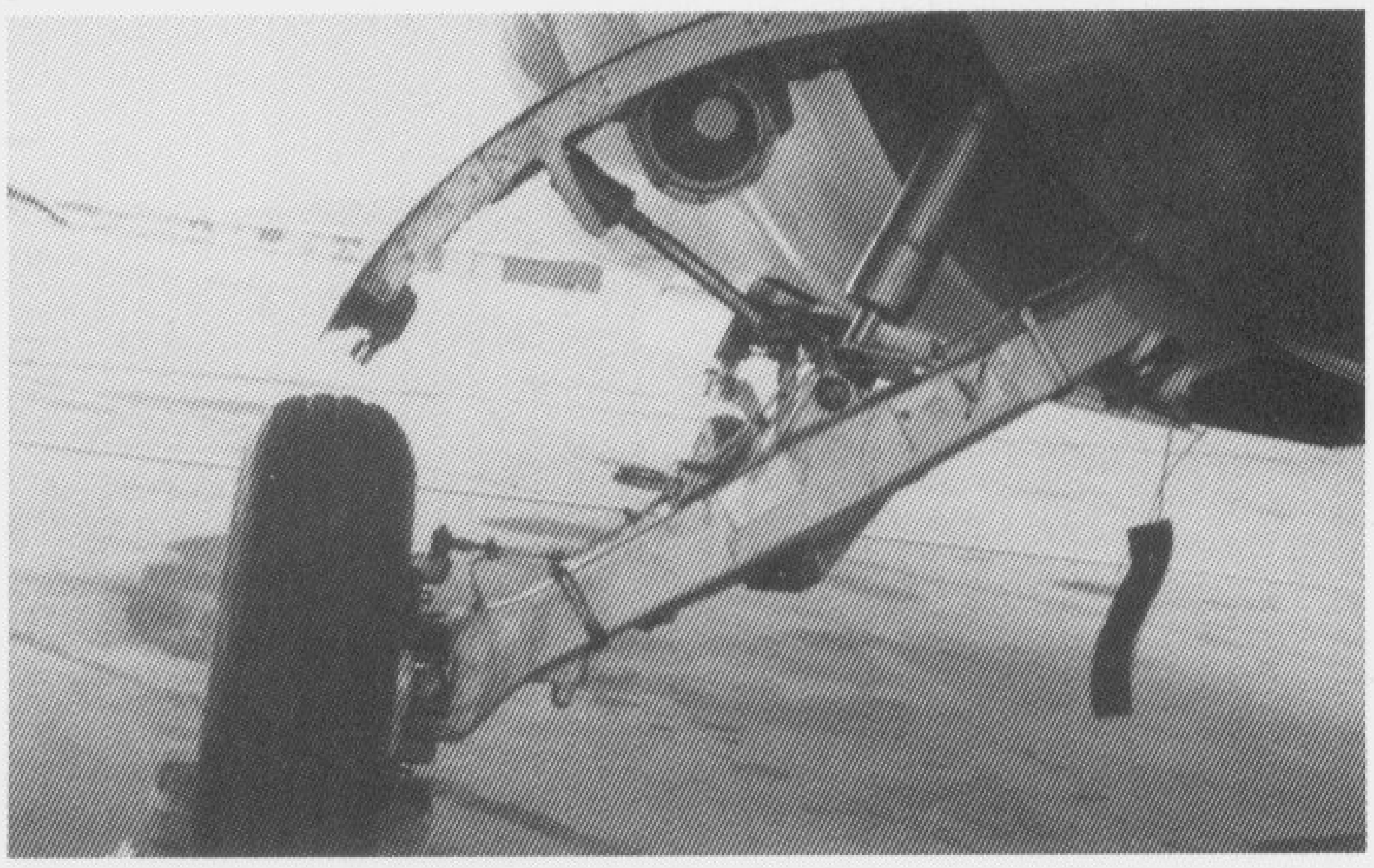
Below left and right: These two views provide a look at the main gear well on the TF-104G. At left is the right side of the well, and at right is a view of the left side.





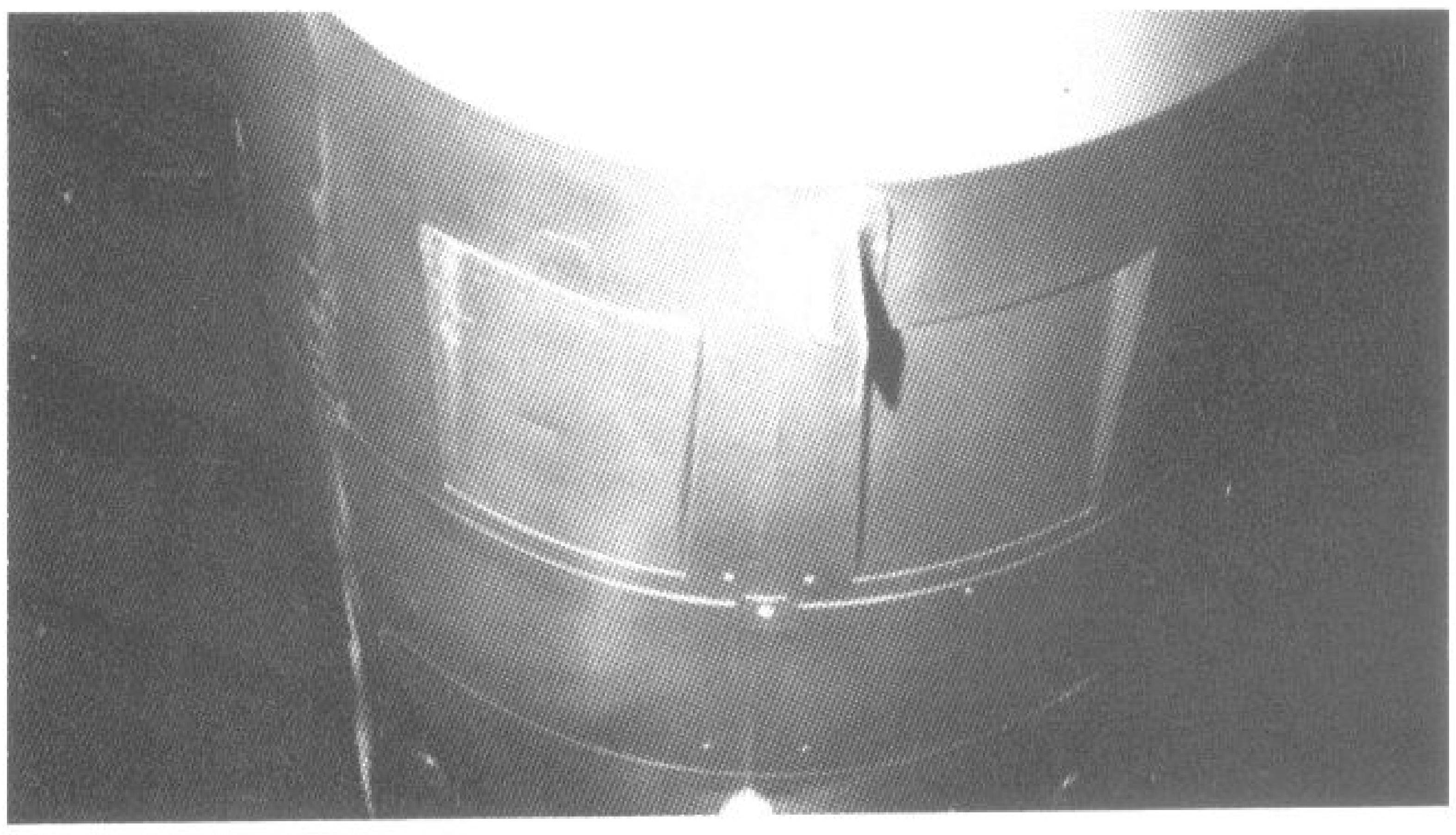




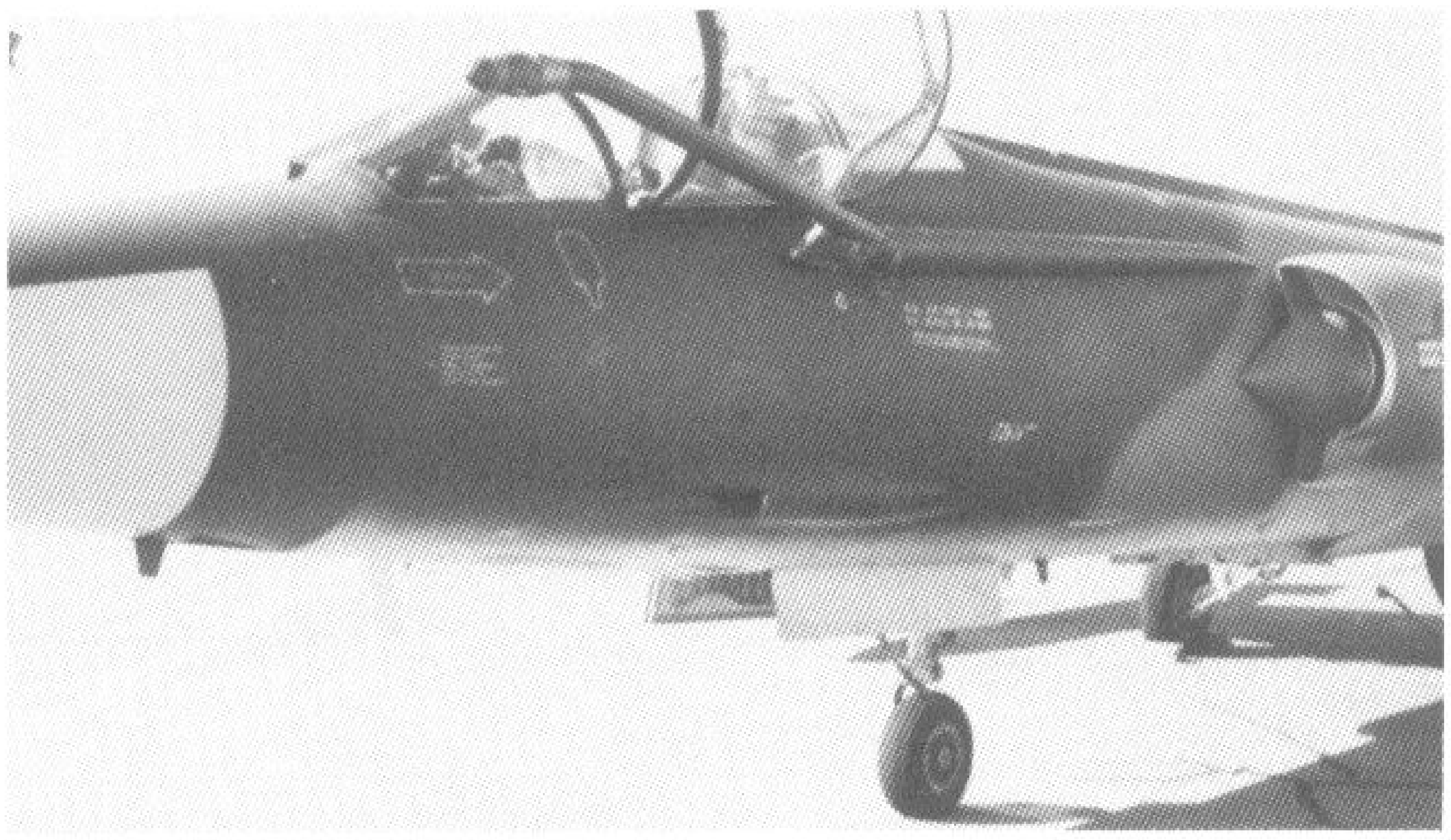


At left is a photo of the left main landing gear on a TF-104G as viewed from in front of the gear and slightly from the outside. At right is the same gear as seen from behind.

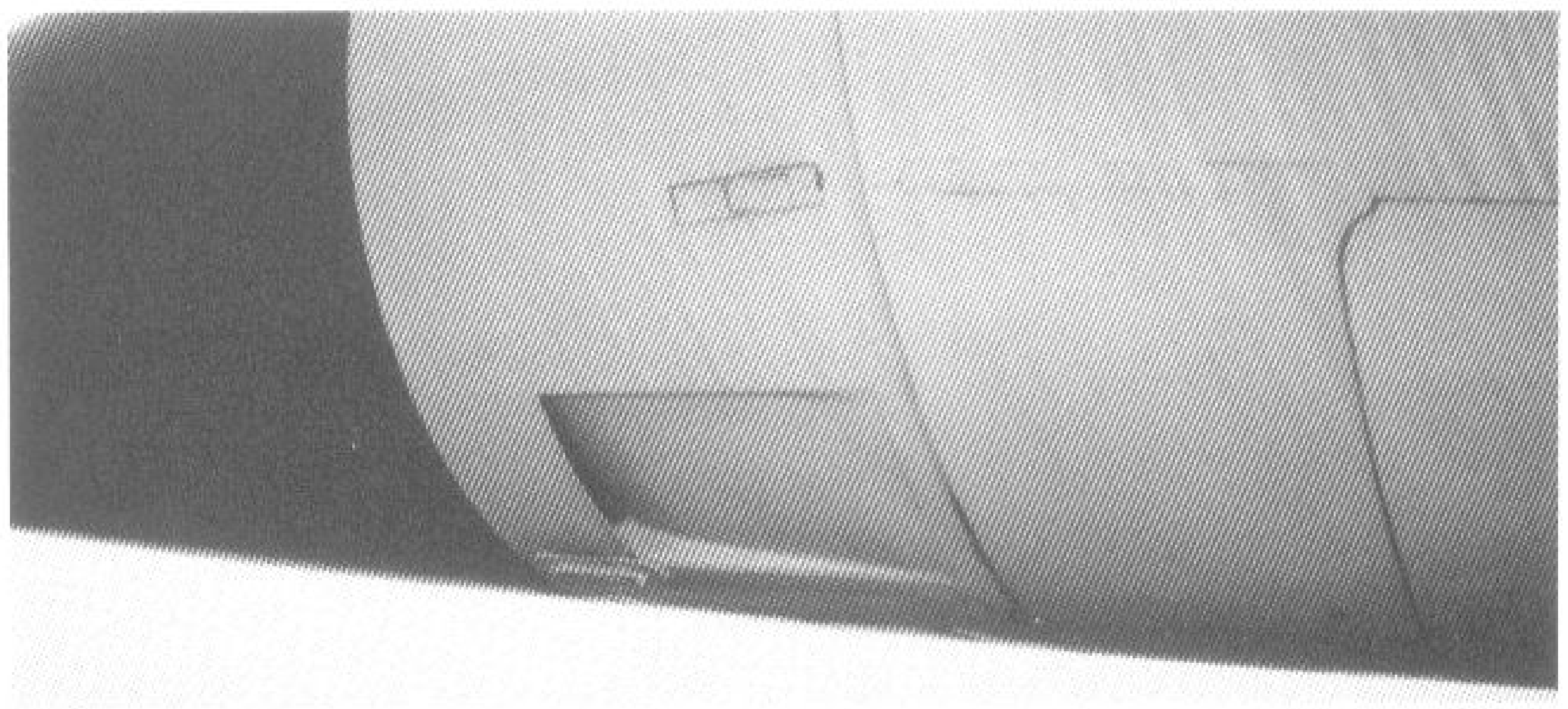
FUSELAGE DETAILS



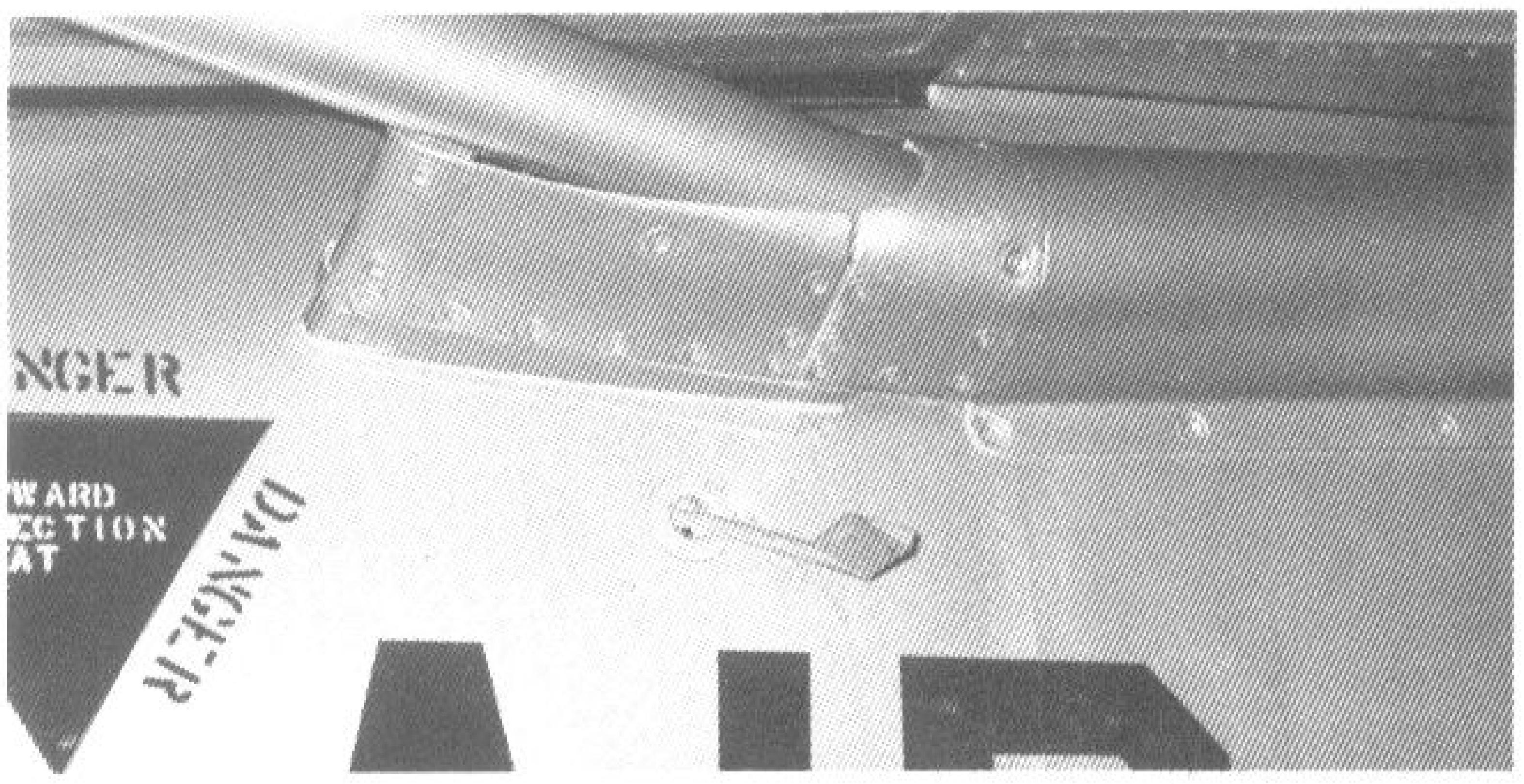
Under the nose section of an F-104C, and just aft of the radome, are two large rectangular vents that exhaust hot air from inside the radar compartment.



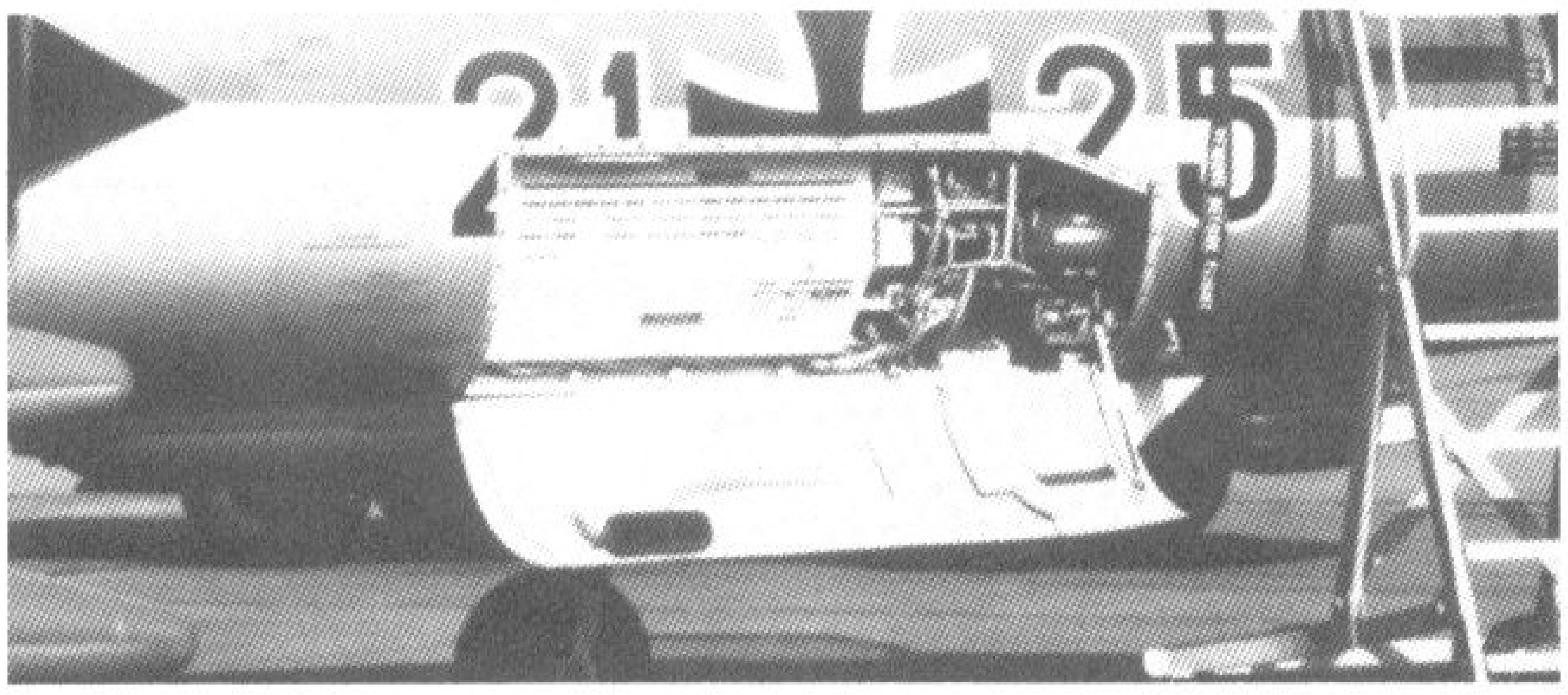
The detachable refueling probe that could be used on the F-104C and F-104D versions can be seen in this view. Also visible is the gun fairing. Note that this particular F-104C does not have the forward extensions on the nose gear doors.

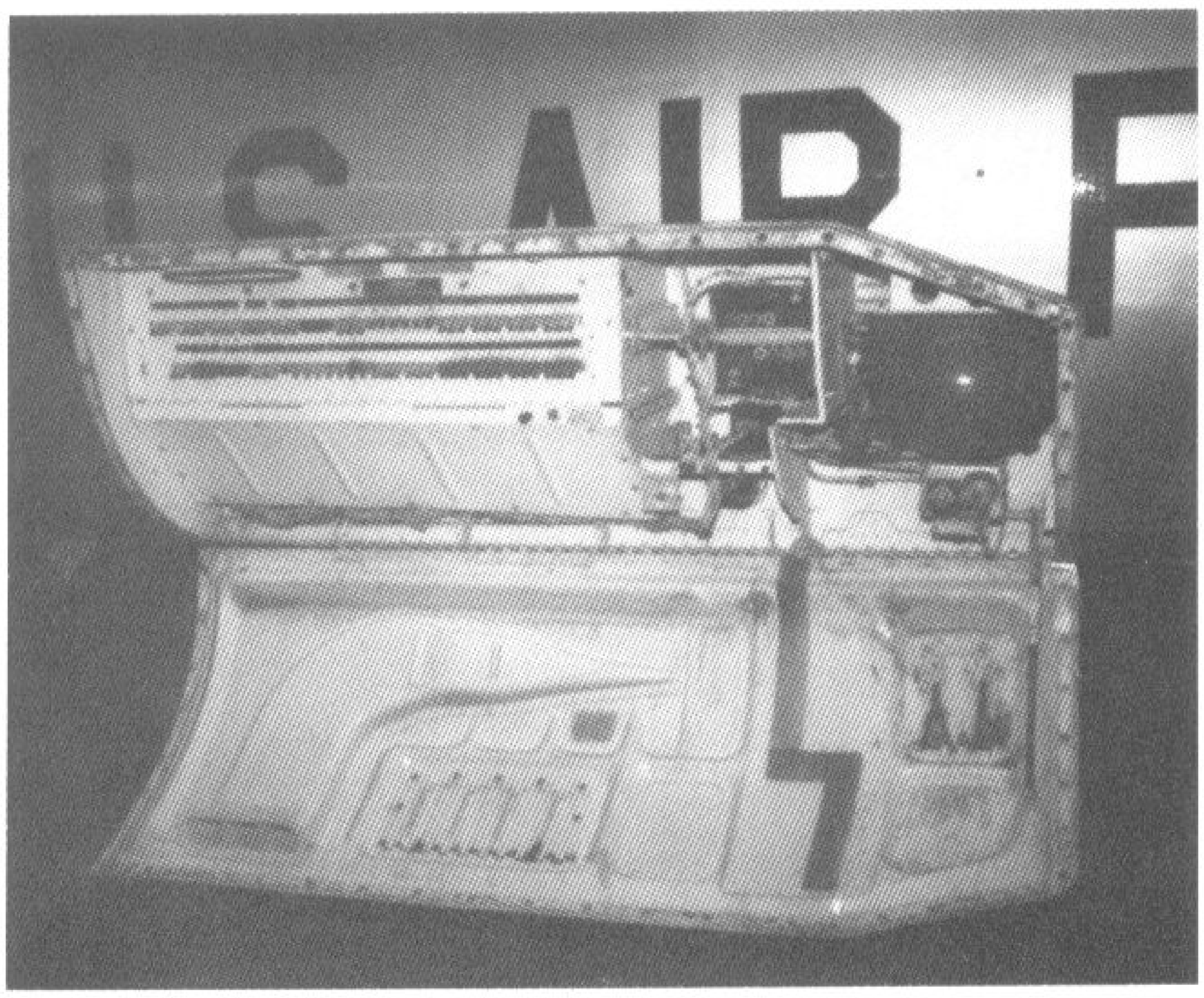


This F-104A had only one vent on the left side. Some F-104As had the single vent, while others had two.



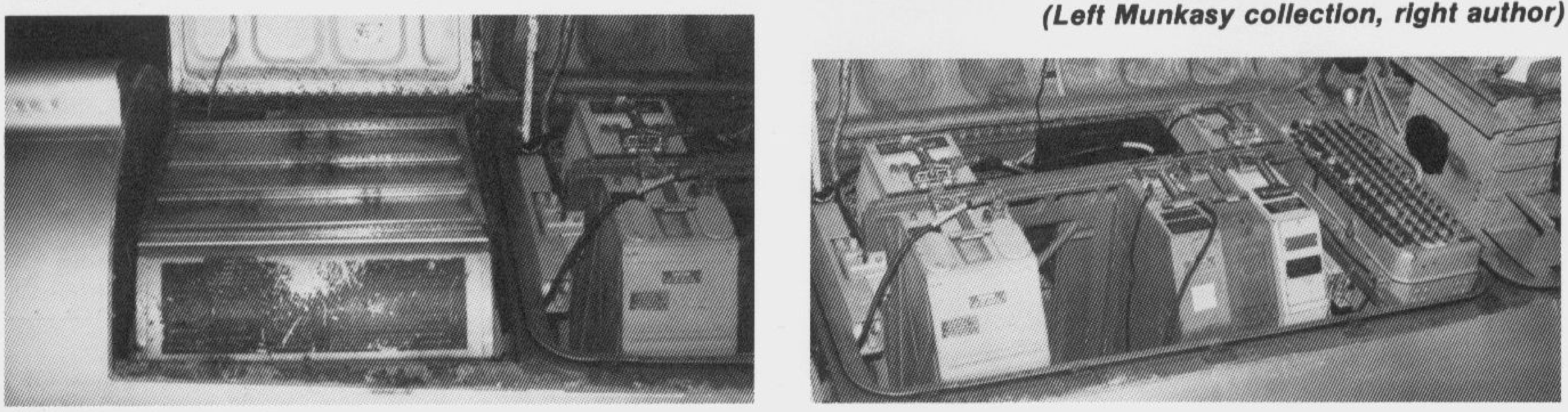
The angle of attack vane was located on the left side of the fuselage just below the aft end of the cockpit and canopy.



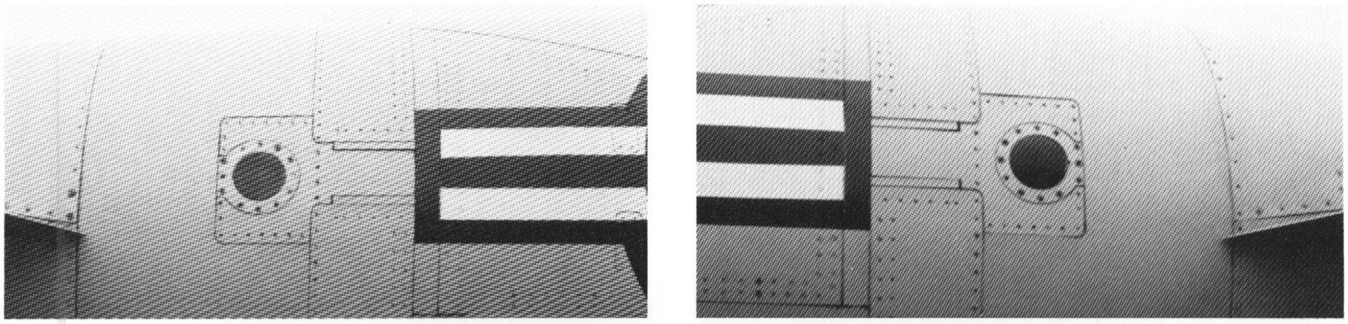


A hinged door covered a large bay on the right side of the forward fuselage. Electronics and other equipment were in this bay. At left is a look at this bay on a German F-104G, and at right is a close-up of the same bay on an F-104C.

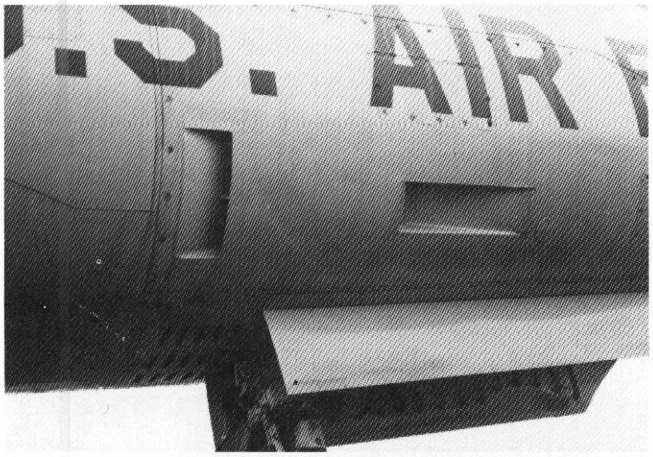
(Left Munkasy collection, right author)

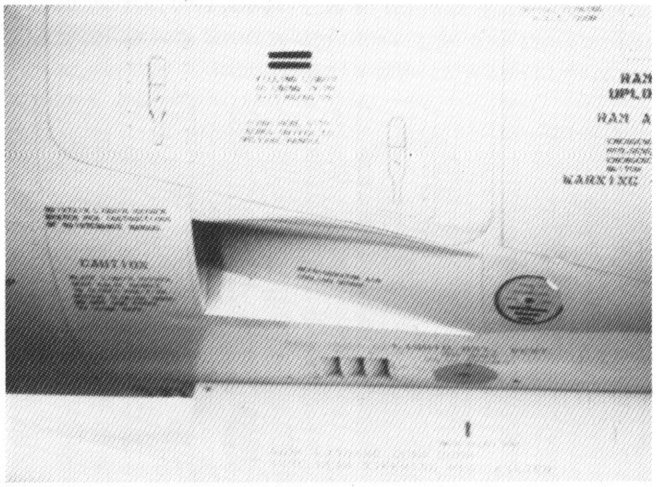


More electronic gear was located in a bay behind the cockpit. At left is the rear portion of this compartment, and at right is the forward portion. This bay was covered by two hinged sections of the upper fuselage and canopy.



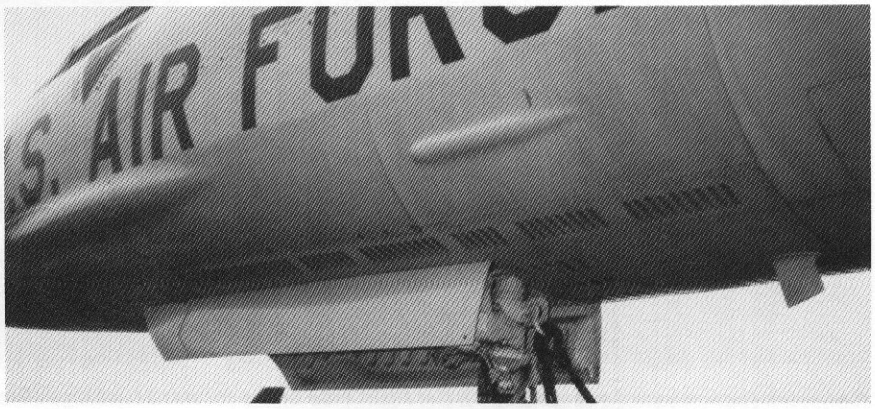
Navigation lights were mounted on each intake just forward of the leading edge wing root. The one on the right intake (left photo) was blue-green while the left light was red.

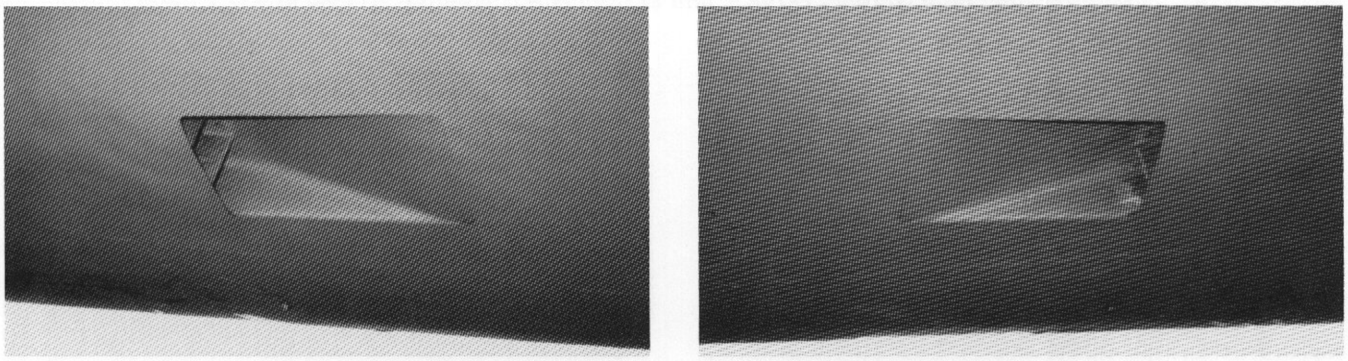




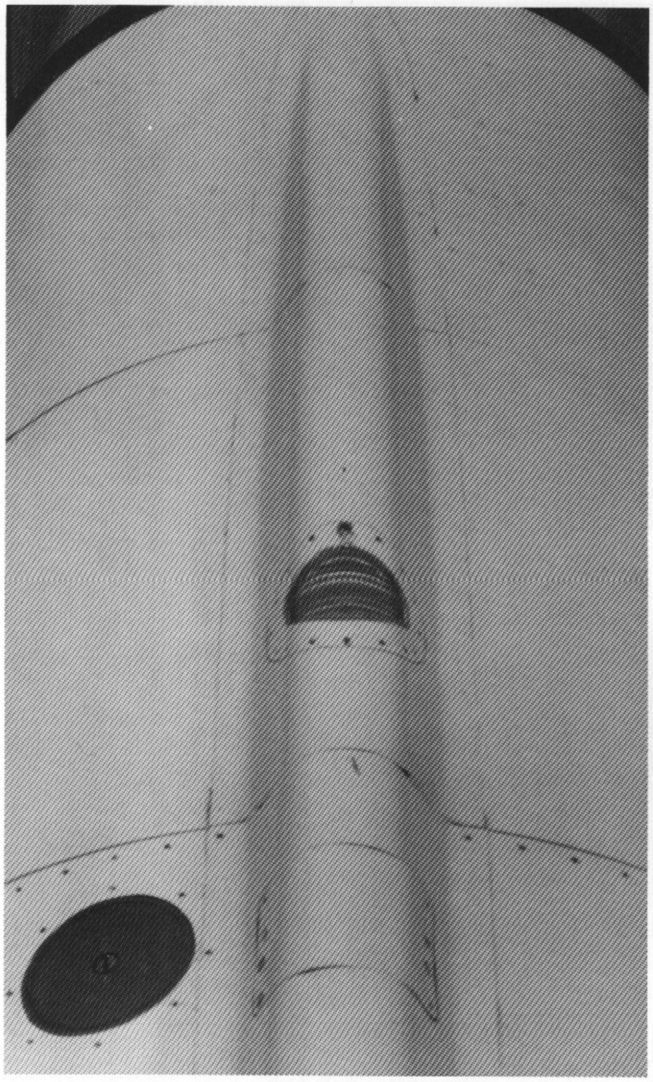
Details of a scoop and vent on the right side of the nose section of an F-104A are shown at left. The same scoop, but on a TF-104G, is illustrated at right. This is the refrigerated air and cooling scoop.

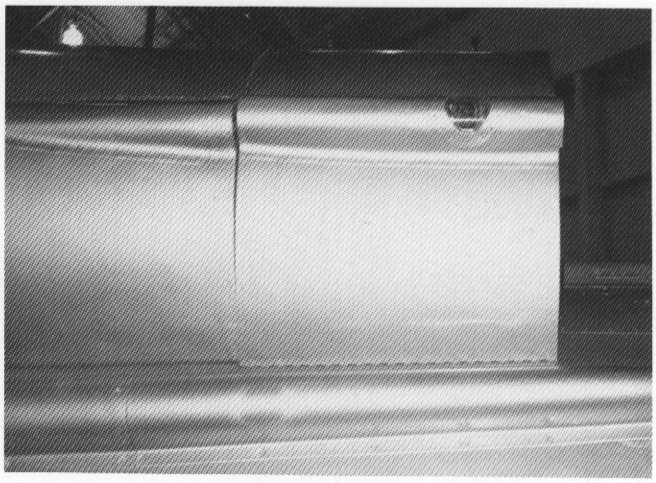
Numerous small vents were located on the underside of the fuselage next to the left nose gear door and aft of the nose gear well to vent gases from the gun compartment. The fairing for the gun muzzle and the smaller fairing on the aft gun compartment door can also be seen in this photo.



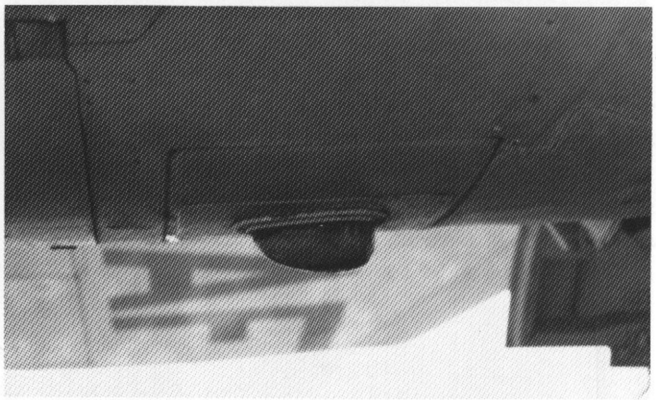


Larger vents were also located on the underside of the forward section of the fuselage as shown in these two views. They were approximately half way between the nose gear and the main gear wells.

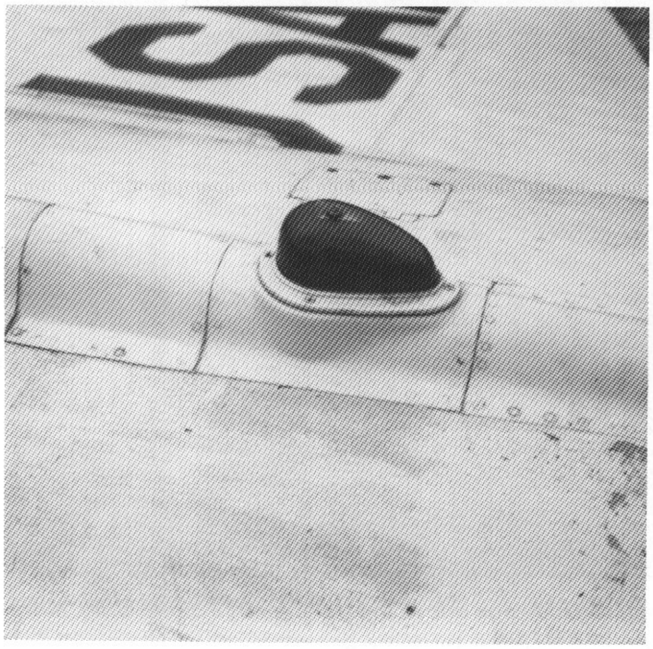


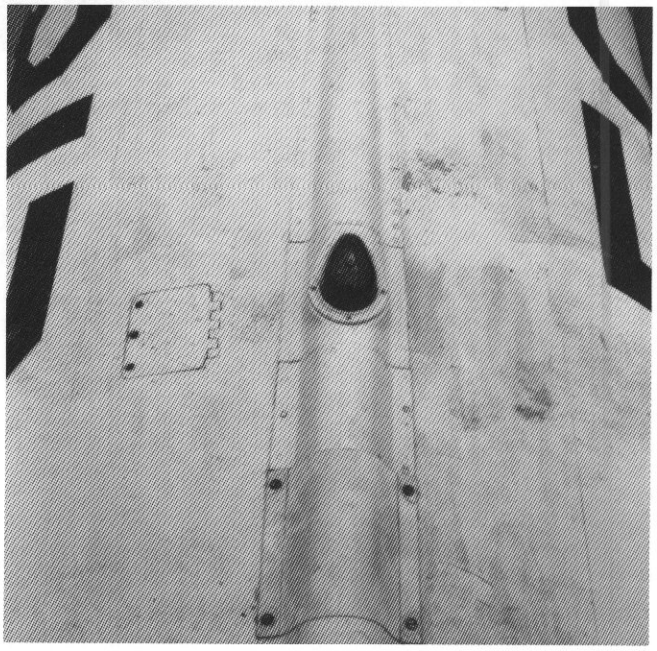


Above left and right: A white position light was located on the spine of the aircraft just aft of the cockpit. It was on the aft cover for the electronics bay behind the cockpit.

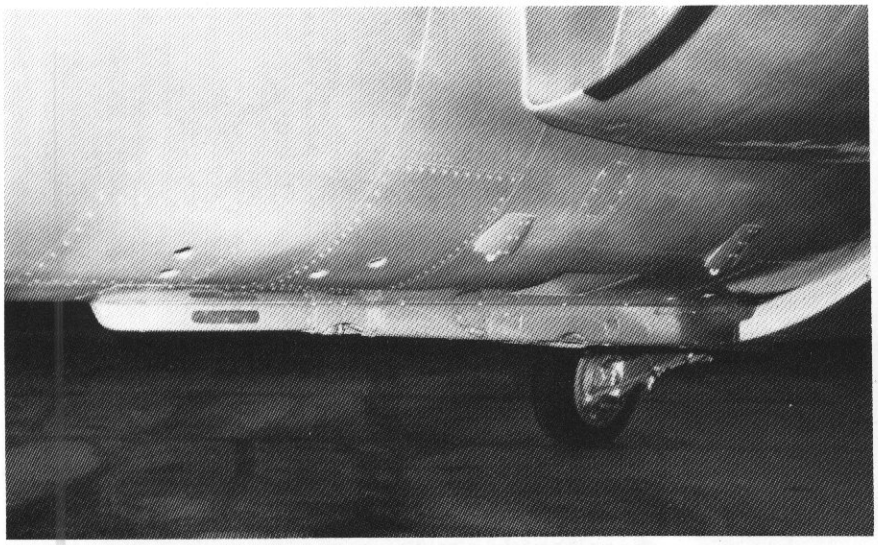


Under the fuselage, and just aft of the main gear, was the lower red beacon.



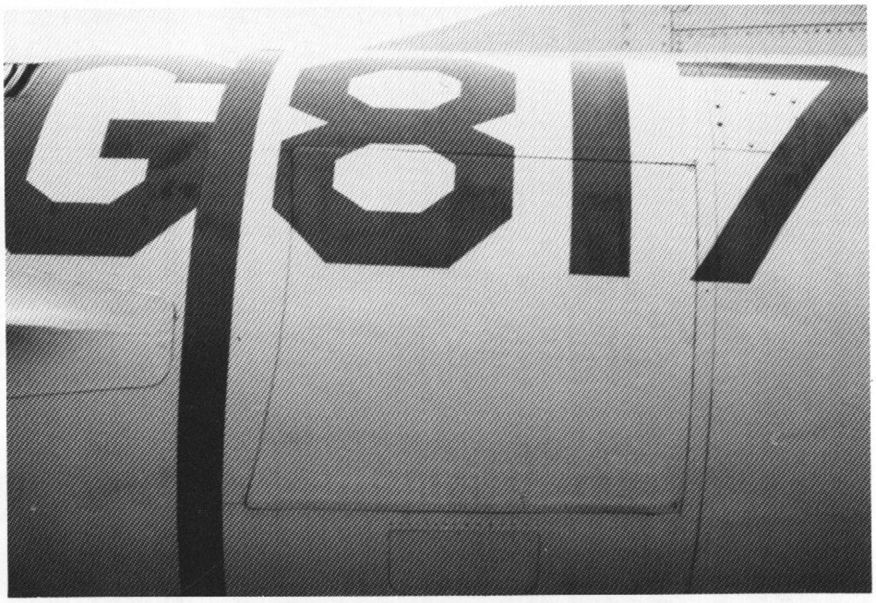


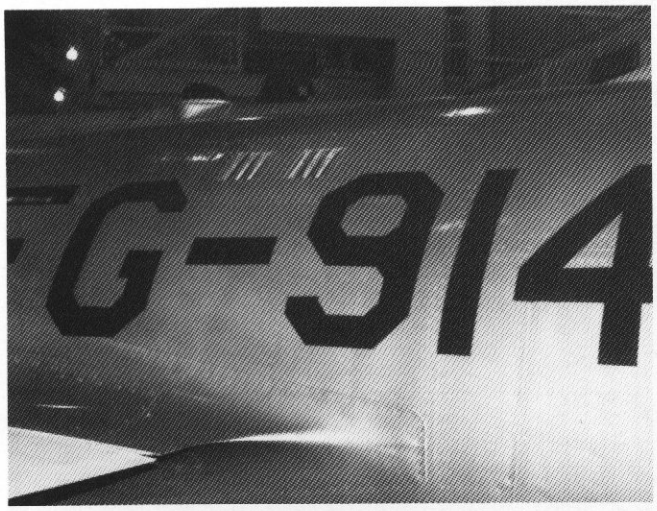
These two views show the upper red beacon which was located on the spine of the aircraft a few feet forward of the vertical tail.

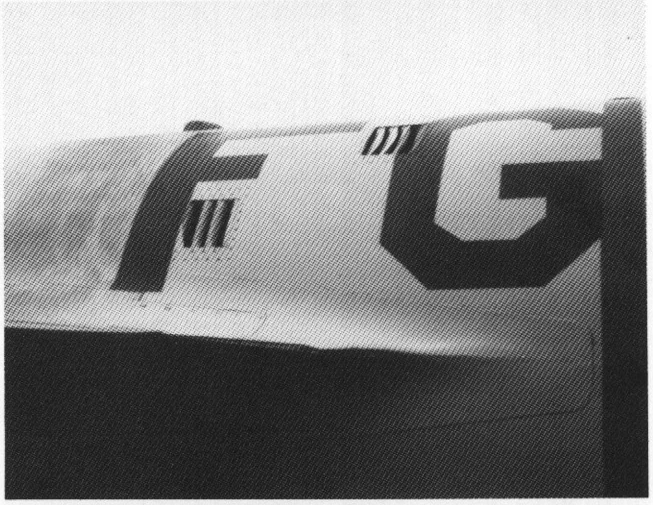


A centerline hardpoint was added to the F-104C, and was fitted to all subsequent versions. Because there was little space between the fuselage and the ground, the removable pylon for this station was very short in its vertical dimension. This photograph was taken from the left side and slightly forward of the centerline station.

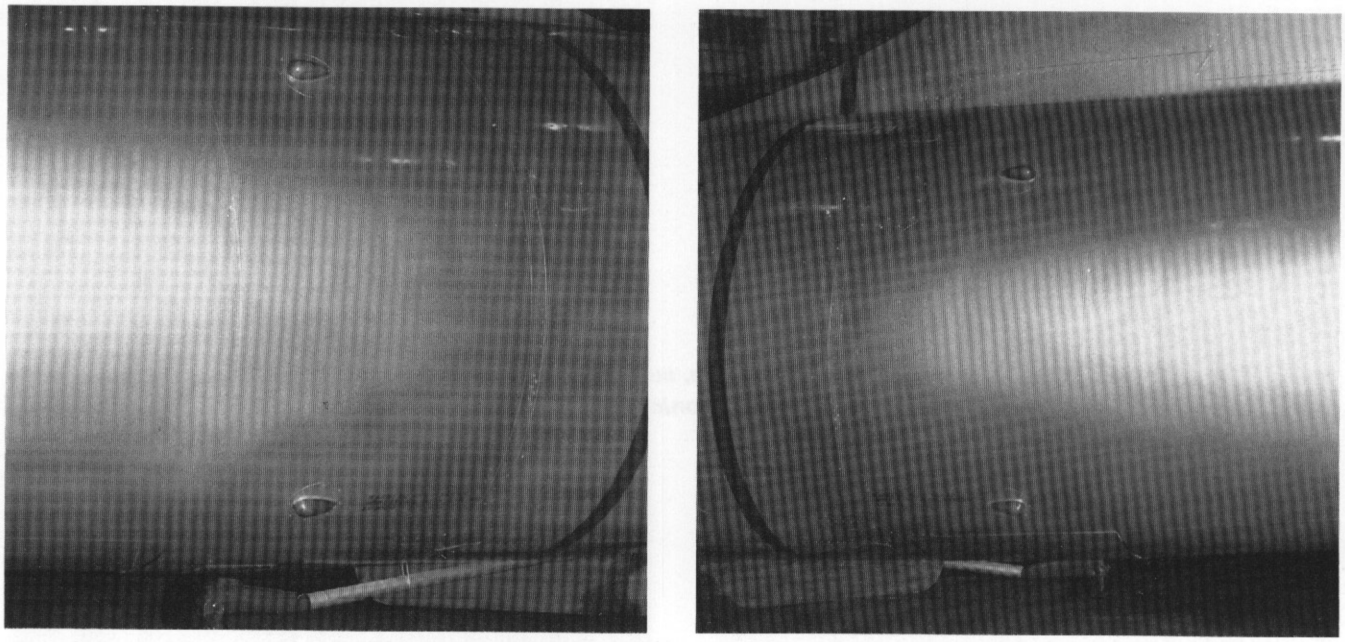
Speedbrakes were located on each side of the aft fuselage. The outline of the left brake can be seen in this photograph.



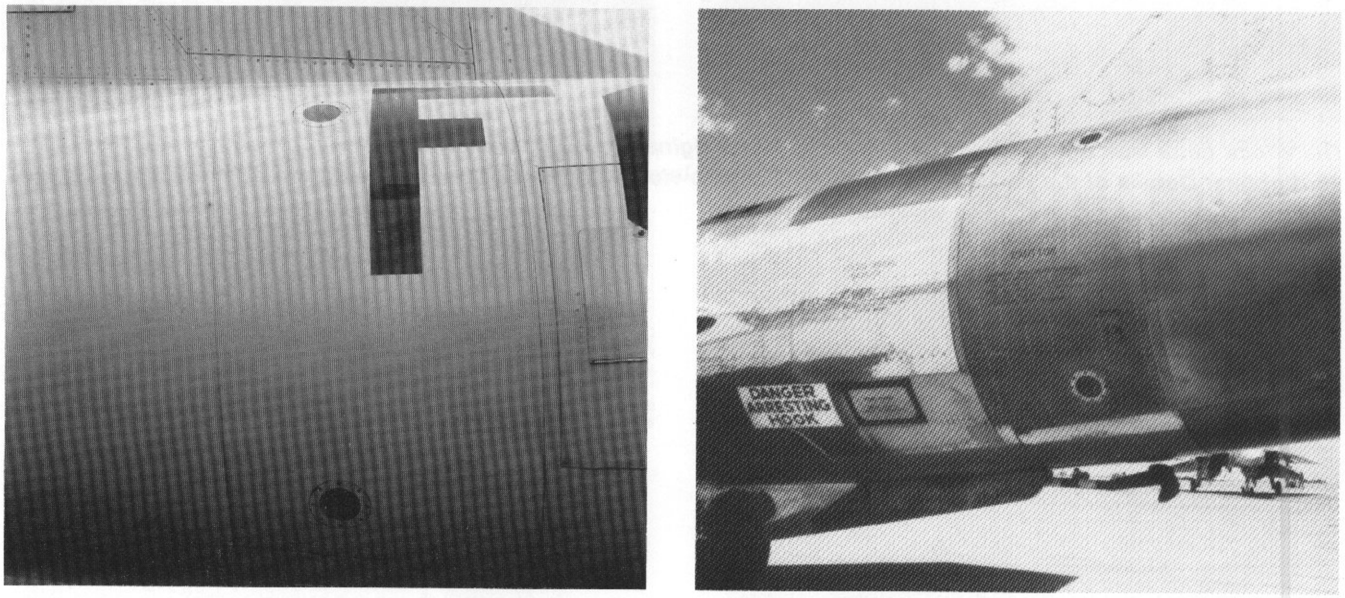




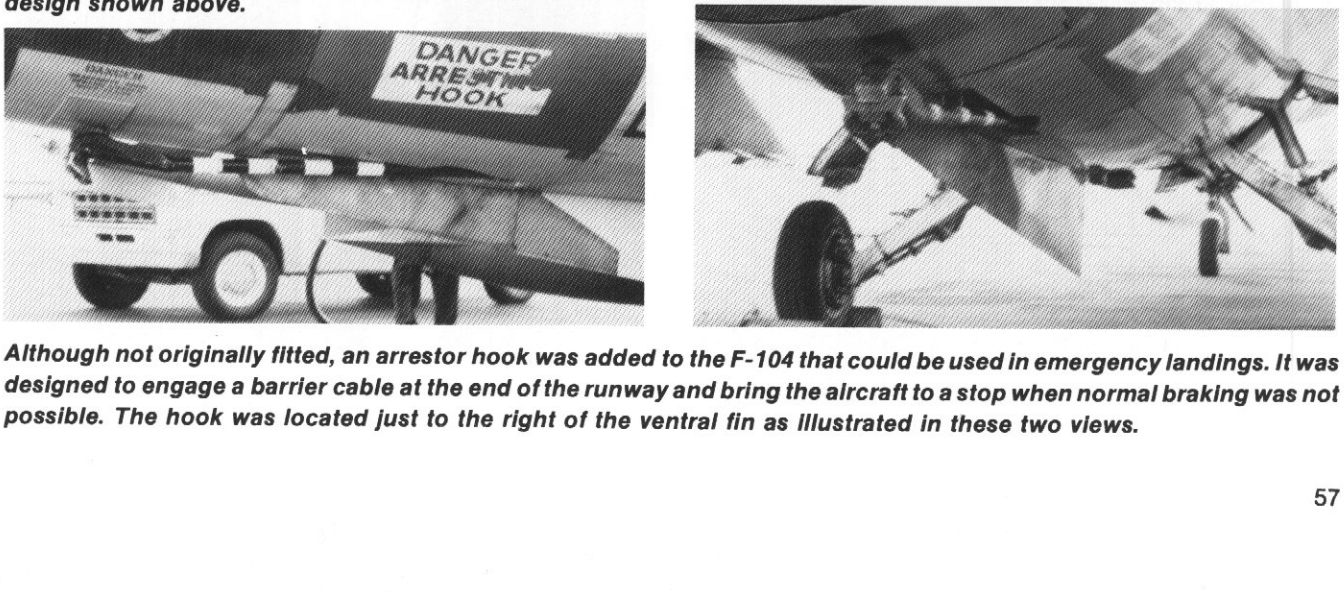
The vents for the primary heat exchanger were on the left side of the fuselage above the trailing edge of the wing. More than one configuration was used as illustrated in these photographs. At left is the more common arrangement with the two vents being visible above and between the G *and the* 9*. At right, the forward vent is considerably lower on the fuselage than the aft vent.*



Two position lights were located on each side of the aft fuselage, and two designs were used for these lights. Some aircraft had the teardrop-shaped lights seen in these two photos.

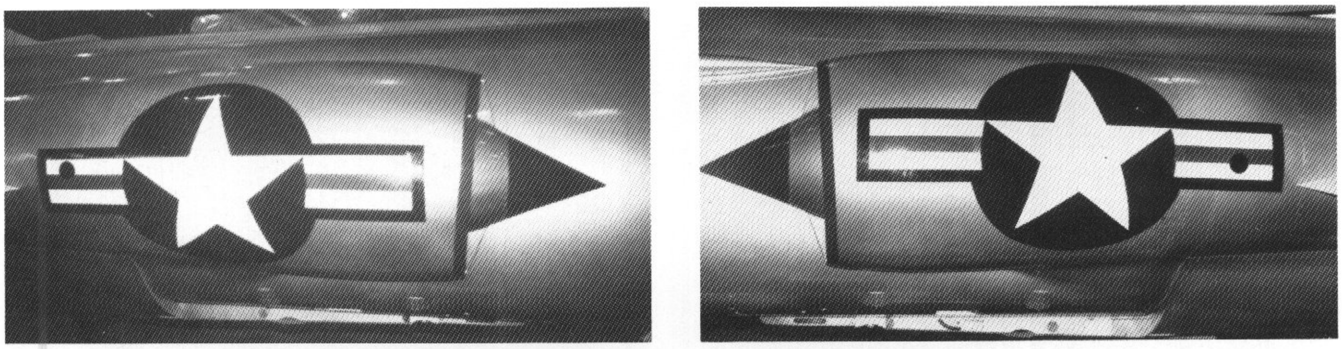


The second design was a flush-mounted light as seen here. Both styles of lights were used on the various examples of each version of the Starfighter, but this flush-mounted light seemed to be used more extensively than the teardrop design shown above.

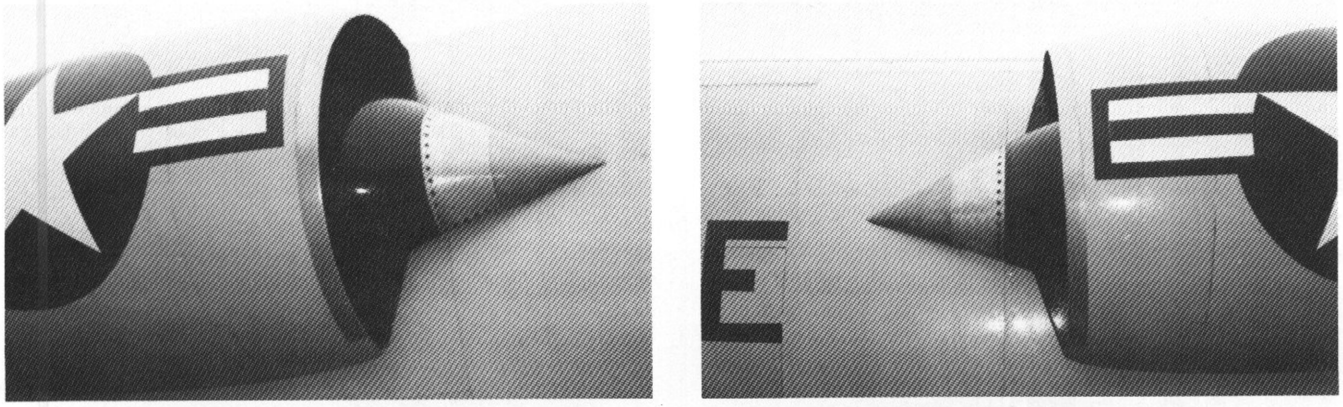


Although not originally fitted, an arrestor hook was added to the F-104 that could be used in emergency landings. It was designed to engage a barrier cable at the end of the runway and bring the aircraft to a stop when normal braking was not possible. The hook was located just to the right of the ventral fin as illustrated in these two views.

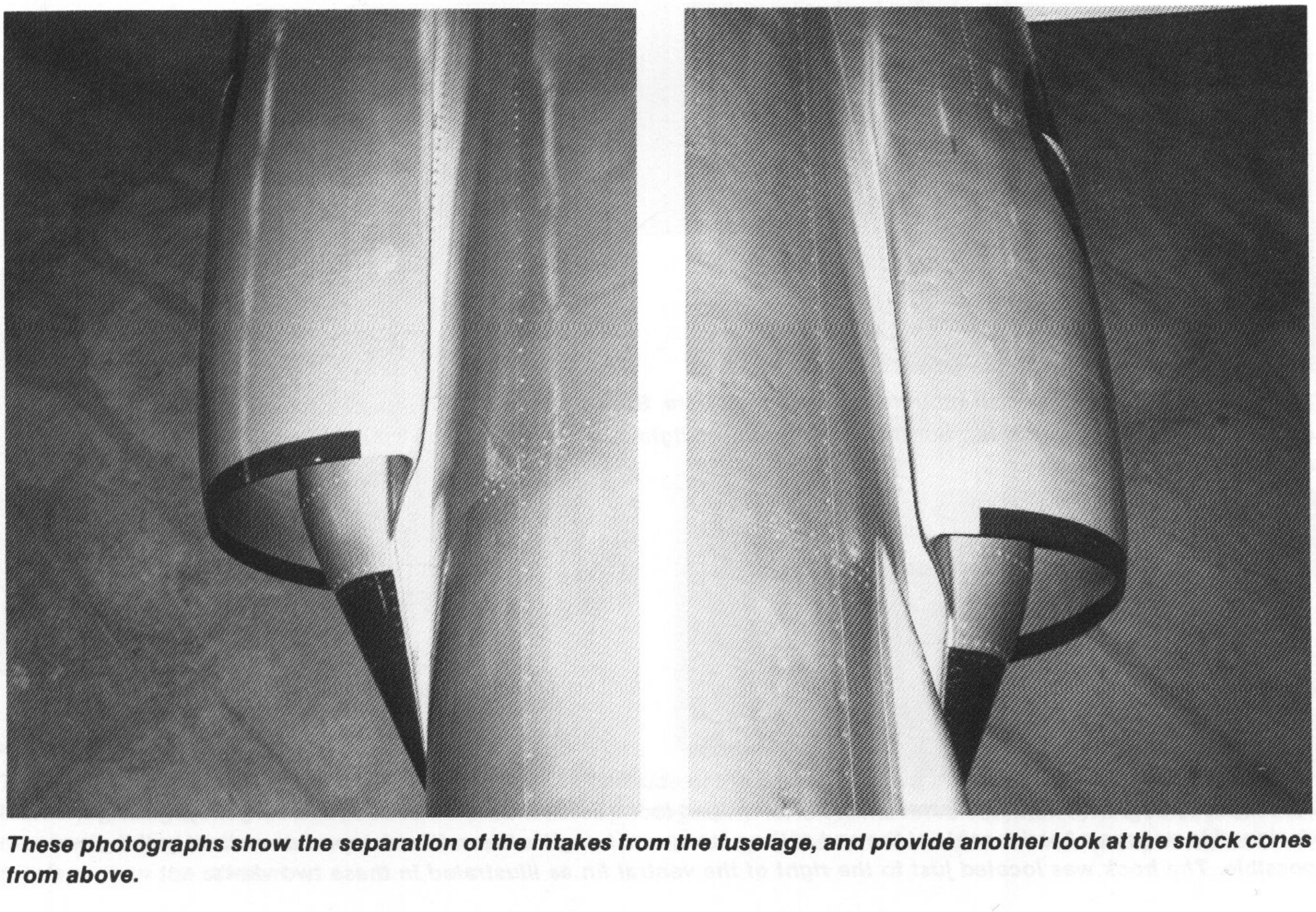
INTAKE & EXHAUST DETAILS



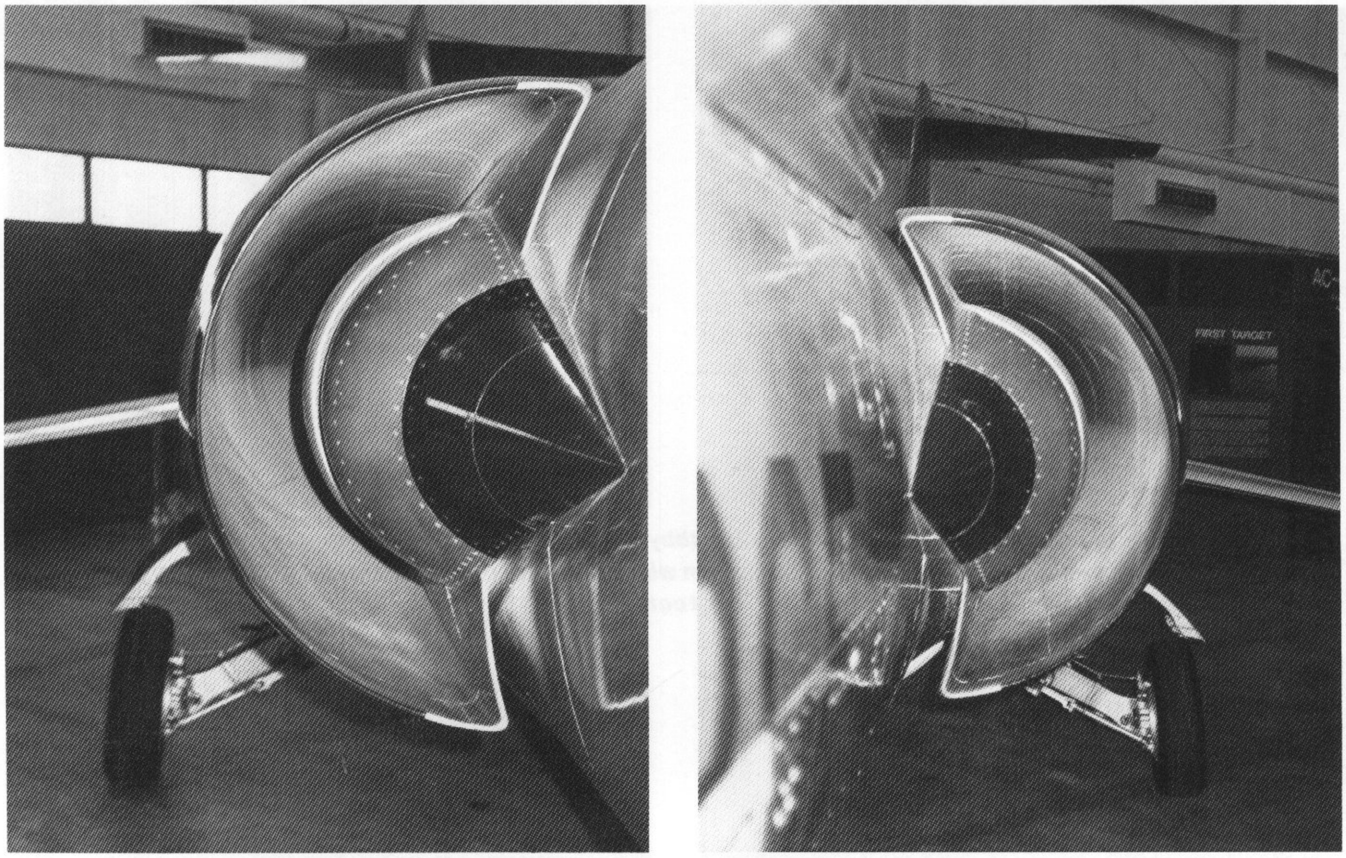
Overall views of the intakes are provided here. The shape, curvature, size, and design of the intakes all contributed to their ability to take supersonic air and reduce it to subsonic speeds that could be used efficiently by the engine.



The shock cone was not fitted in the intakes on the original XF-104s, but became a standard feature on all future Starfighters. Details of the cones are visible in these two views as well as the two below.

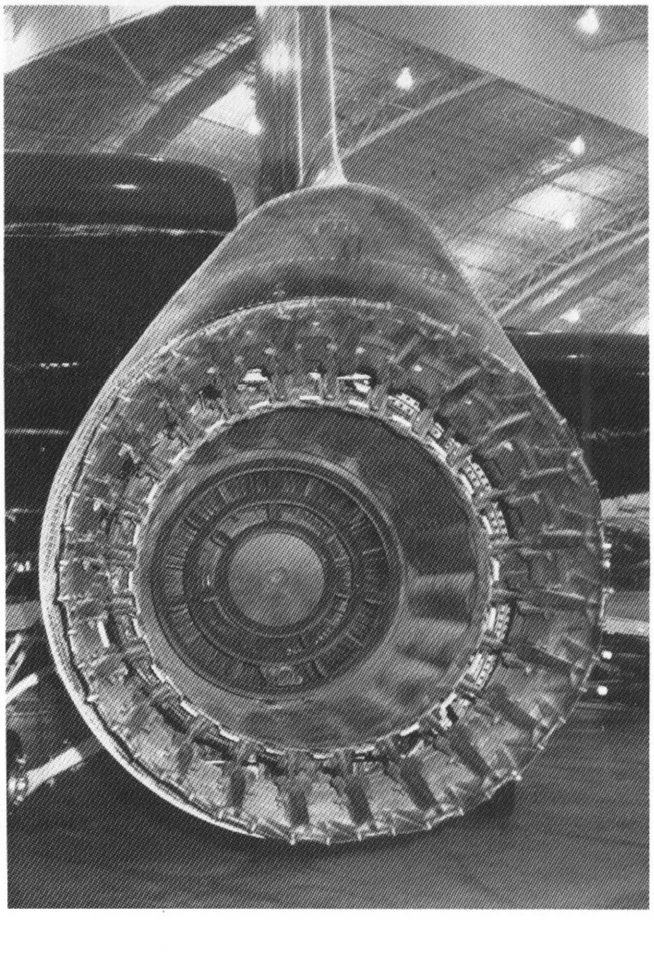


These photographs show the separation of the intakes from the fuselage, and provide another look at the shock cones from above.



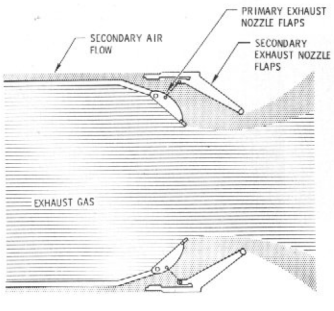
The cross section and the interior of the intakes are revealed in these two photographs.

With the wheels in chocks and the aircraft chained to the ground, a pilot runs up the engine and lights the afterburner during engine checks. The exhaust flame is highlighted against the darkness of night and is most impressive.

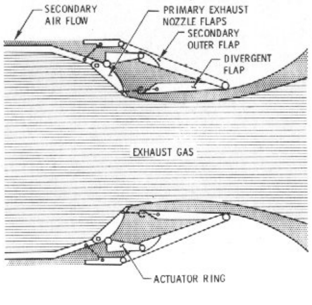


Right: The inside of the afterburner, the convergent/divergent nozzle, and the flameholder are illustrated in this photograph.

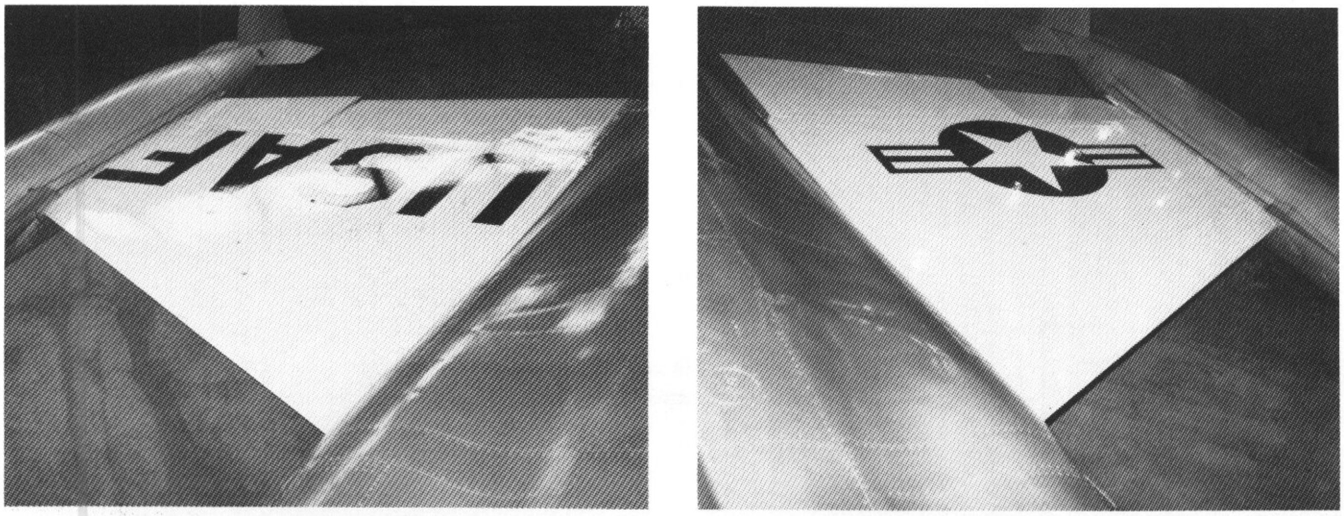
EXHAUST NOZZLE 3B (7A)



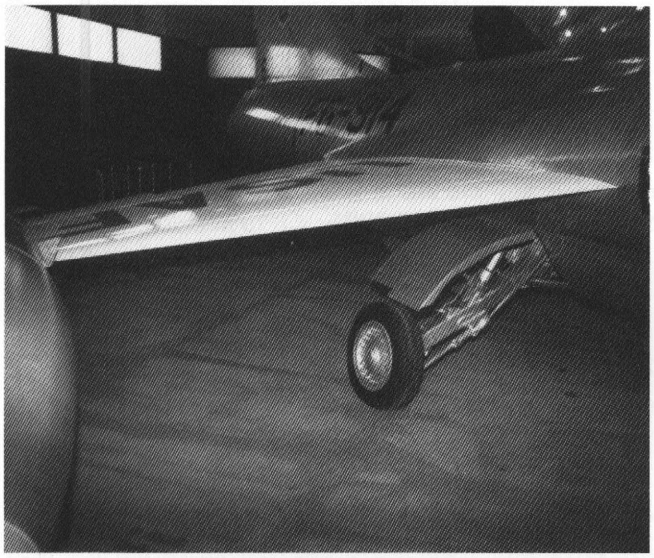
GUIDED EXPANSION EXHAUST NOZZLE 19



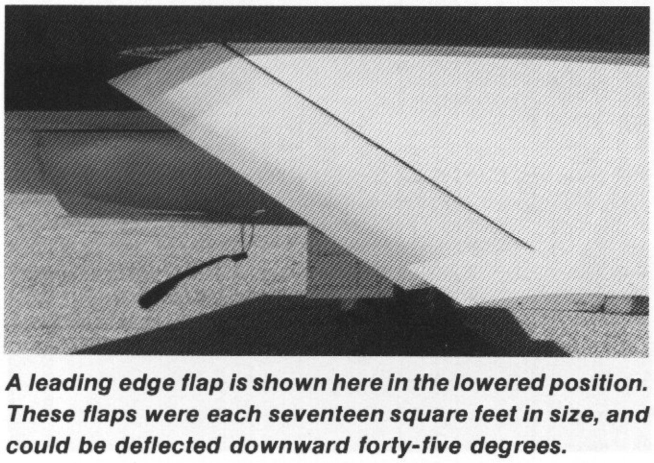
WING DETAILS



Of all the Starfighter's design features, it was the short, stubby wings that got the most attention. With a span of only 21.9 feet, it seemed aerodynamically impossible that these thin wings could lift the aircraft into the air. Wing area was 196.1 square feet, and the wings had a ten degree dihedral. Root cord was 155.83 inches, and tip chord was 58.73 inches. A top view of each wing is provided here.

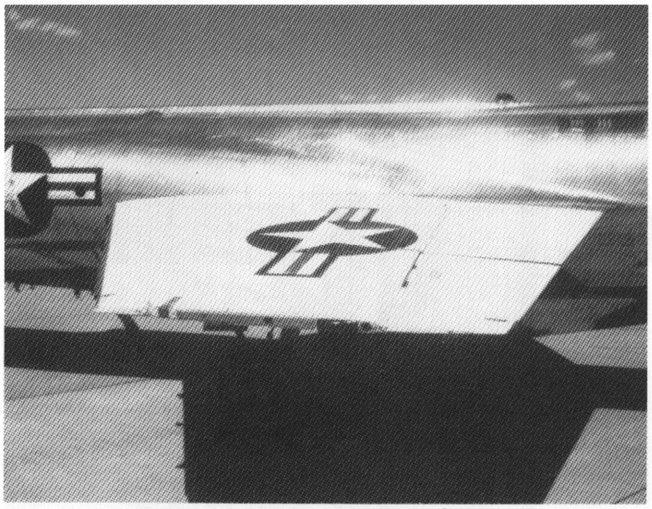


To protect crewmen on the ground, protective strips were placed on the leading edge. These strips can be seen in this photograph with REMOVE BEFORE FLIGHT streamers attached to them.

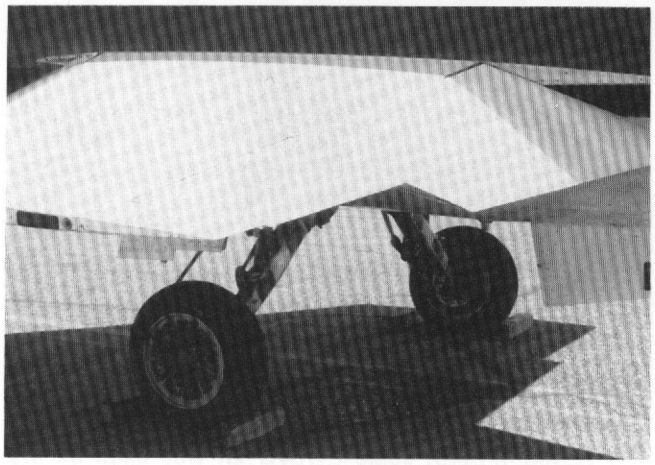


A leading edge flap is shown here in the lowered position. These flaps were each seventeen square feet in size, and could be deflected downward forty-five degrees.

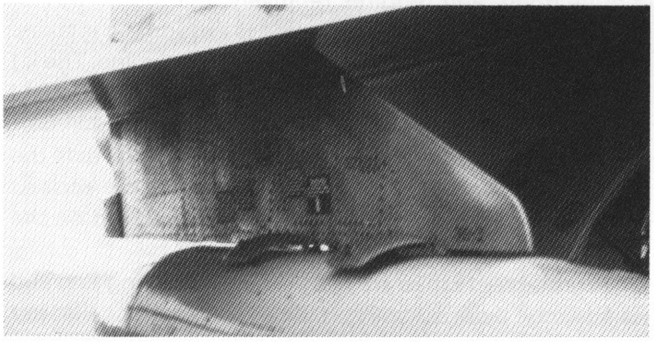
The leading edge was reported to be "razor thin." In fact, it was 16/1000th of an inch in radius, or about the same as a common table knife, making it the thinnest leading edge ever on a fighter aircraft.



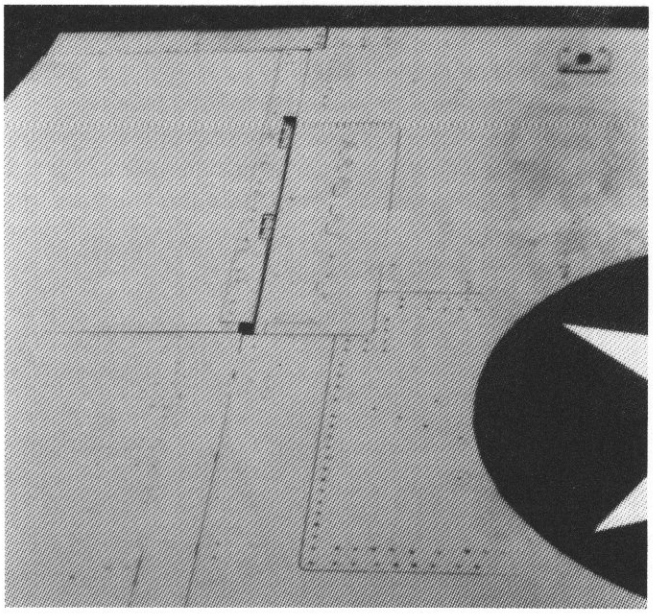
With no fuel tank or missile rail attached, details of the wing tip are visible in this photograph.



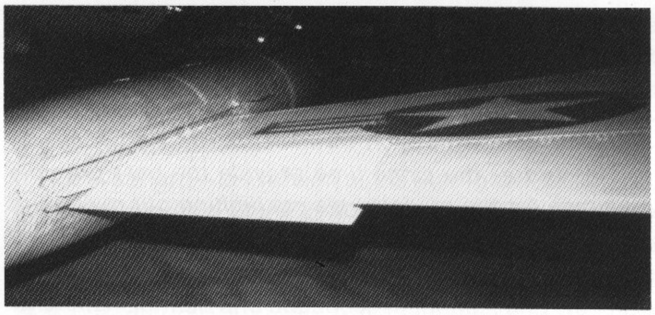
Trailing edge flaps were positioned on the inner portion of the wing. These flaps were 23.10 square feet in area, and could be deflected downward forty-five degrees. In this view, the trailing edge flap can be seen deflected about twenty-five degrees, while the aileron is in the neutral position.



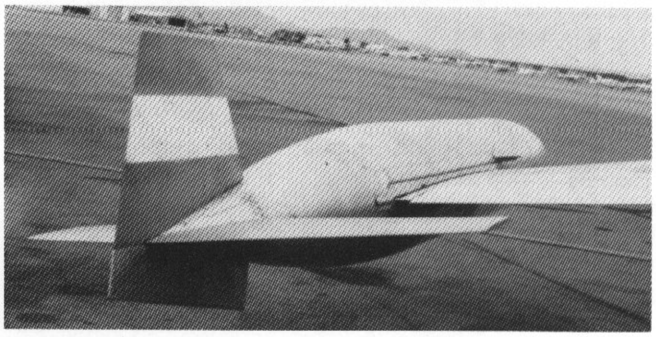
Wing pylons could be carried on all Starfighters. On USAF versions, only one pylon could be fitted under each wing. Details of one of the pylons are illustrated in this view.



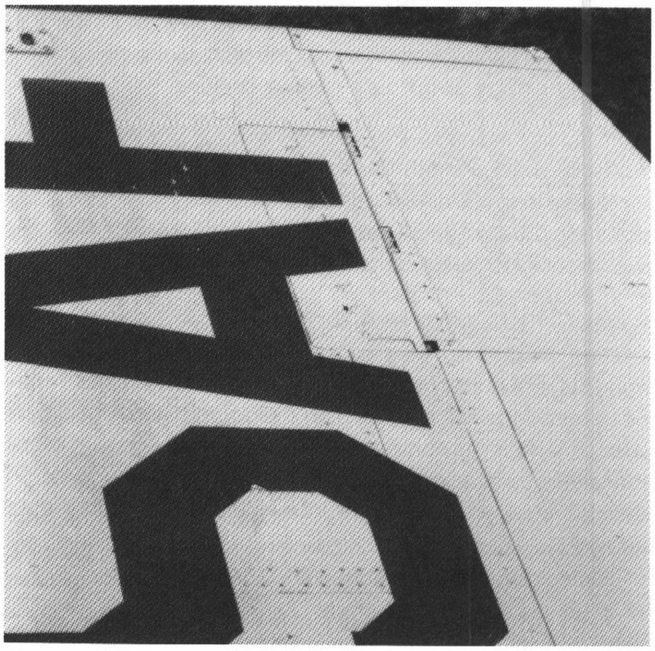
Aileron hinge details are shown in these two views.



Ailerons were outboard of the trailing edge flaps. A slightly deflected aileron is shown here. Ailerons were only 9.46 square feet in area and could move to a plus or minus fifteen degrees.



Because of the rather limited internal fuel capacity, external fuel tanks were often carried by F-104s. These could be carried on the wing tips and on the pylons under the wings. One of the places these tanks differed was the fin arrangement. The horizontal fins used on the wing tip tanks of USAF Starfighters were the same size and shape on each side of the tank, while foreign variants had a longer inner fin as shown here. On underwing tanks, the vertical fin did not extend down below the tank as it did on the tip tanks, and the horizontal fins were the same size and shape with untapered trailing edges.



MODELERS SECTION

Note: There have been over seventy kits of the F-104 Starfighter issued over the years. Many of these are re-releases of earlier kits, but there are still over thirty different molds. Space does not permit us to include a complete review of each of these. In order to conserve space, and at the same time provide the best possible coverage for the modeler, we are limiting our reviews to the better kits in each scale. However, we have included some general comments on the other kits that would be considered of value to collectors. We have also grouped releases and re-releases of the same kit together so that one review can serve for all of the releases.

KIT REVIEWS

1/240th Scale Kit

Monogram F-104, Kit Number P407

This kit was taken from the previously issued Air Power kit, Monogram number PA56, which contained models of five aircraft. These included the F-100, F-101, F-102, F-104, and F-105. Everything except the horizontal tail was one piece, and decals consisted of only the basic USAF markings. Today, this kit is worth between ten and fifteen dollars to collectors.

1/144th Scale Kits

Crown F-104J, Kit Number 7

The original kit of the Starfighter in 1/144th scale was this issue from Crown. It has been reissued by Revell, and is reviewed in more detail below. This issue was actually released twice with different box art, but the same plastic and decals were inside. For such a tiny model, the kit was rather complex, consisting of thirty-six parts of silver plastic and a clear canopy. Two tip tanks were provided, as were underwing tanks and fuselage-mounted Sidewinder missiles and launch rails. Basic Japanese, German, and USAF markings were provided on the decal sheet. This kit is generally considered a collector's item, but only brings about two to four dollars.

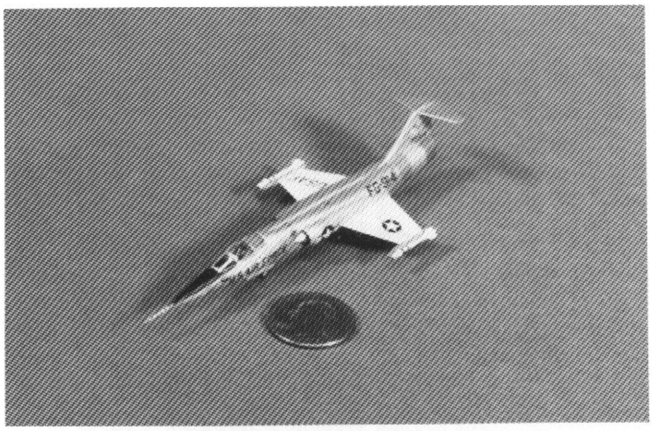
Revell F-104G, Kit Number 1040

Revell first re-released the Crown kit in 1982. It had the same plastic and decals as the Crown kit, and also brings two to four dollars from collectors.

Revell F-104G/J, Kit Number 4011

The second re-release of the Crown kit came in 1990, and this one is still presently available. German and Japanese markings are provided on the decal sheet, but otherwise, the kit is the same as the previous two issues. One of these was built as a review sample, and the comments on this kit also apply to the Crown and Revell kits listed above.

This is one of the better 1/144th scale fighter models that we have built. Shapes are generally correct, and nothing looks out of proportion on the finished model. Fit is quite good, and requires relatively little in the way of filling and sanding. One exception is around the intakes, but this is a problem area on most Starfighter kits. The kit is a large-tail version representing the F-104G and F-104J that the box art indicates, but building an F-104A or F-104C is quite simple. All that is required is that the rudder be cut away from the vertical tail at the scribed hinge line, and a new rudder must be rescribed on the vertical tail surfaces.



The Revell 1/144th scale F-104G kit was used by the author and modified to build this model of an F-104C. Although it lacks the details of the larger kits, this is a good kit as 1/144th scale kits go, and it builds up into a nice little model of the Starfighter. The quarter gives an indication of the finished model's tiny size.

External fuel tanks are provided for the wing tips and underwing pylons, while Sidewinders and rails are included to be mounted under the forward fuselage. It is a simple matter to mate the launch rails to the wing tips and place the Sidewinder missiles in that location if the modeler prefers, but the locating slots under the fuselage must be filled. The wing pylons can be left off if the holes in the wings are filled, or the pylons could be used to carry the fuel tanks provided in the kit. Bombs or rocket pods from other 1/144th scale kits or weapons sets could be substituted on the pylons instead of the tanks.

As would be expected on a model this small, detailing does not equal that found on larger kits. The forward main gear doors are molded in the completely closed position instead of being partially open. The landing gear can be built in the raised or lowered position, and the gear itself is passable for a model this small. However, some modelers may wish to add details using fine wire.

The ejection seat is the only detail in the cockpit, and the plastic for it is too thick. It is easy to build a much better one from plastic card, and other basic detailing can enhance the appearance of the cockpit. The nose gear doors are also too thick, and are best replaced with ones made from thin plastic card.

Decals used on our sample model were taken from other kits and sheets for 1/144th scale models, and the result was a nice model of an F-104C in basic TAC markings. Overall, this is a good kit, and we recommend it.

1/110th Scale Kit

Comet F-104, Kit Number PL29

Comet issued this rather crude and simple kit in 1954, and it is now quite difficult to find one except on some collectors' shelves. It brings only about three to six dollars, but that is assuming that you can find one. This kit has no value to the serious modeler.

1/100th Scale Kits

UPC F-104, Kit Numbers 7031 and 7035

These two early kits of the Starfighter are no longer available, and only bring from two to four dollars on the collectors' tables. They cannot be considered by the serious scale modeler.

Heller Cadet, Kit Number LO24

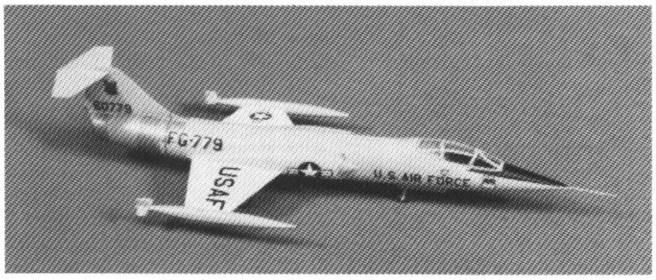
Issued in 1963, this too is a very early kit of the F-104, and cannot be considered by the serious modeler. It consisted of twenty-one parts in silver plastic and a clear canopy. The pilot was molded into the seat, and this provided all of the cockpit detailing, as was the case for most kits from this time period. This kit is best left to the collectors, but they will only pay from two to four dollars for it.

Tamiya F-104J/G, Kit Number PA 1008

This was the first release of this kit that was subsequently issued under the Ben, RMM, and Revell labels. We built one of these original issues as our review sample.

There are thirty-five pieces in silver plastic, a two-piece white stand, and a clear canopy. Two tip tanks are provided, underwing pylons carry rocket pods, and fuselage rails for Sidewinder missiles are included. If a Japanese aircraft is built, the rocket pods would be inappropriate, since Japan only uses its Starfighters for air defense. Again, it is a simple matter to put the Sidewinder missiles and their launch rails on the wing tips if desired.

The scribing on this model is a little too heavy, and fit is not good. A considerable amount of filling and sanding is required. There are some shape problems too, and the tip tanks are noticeably too narrow. There are no wheel wells, and the landing gear is not well detailed for a kit this size. The treatment of the triangular-shaped pieces at the leading end of the nose wheel doors is incorrect. Cockpit detailing consists of only a crude seat, and it is large enough that most modelers will want to add some detailing of their own.



The Tamiya 1/100th scale F-104J/G kit was modified by the author to build this model of an F-104A. It has some shape problems, especially around the aft fuselage and intakes. The tip tanks are also the wrong shape, being too thin.

This is a large-tail version of the Starfighter, but again, converting it to a USAF F-104A or F-104C is relatively simple. We built ours as an F-104A in the ADC gray and white scheme. Decals will pose a problem though. The kit only has German and Japanese markings, and we know of no after-market decals in this scale. This means that some fudging will be necessary when it comes to the markings.

Overall, we cannot give this kit high marks. But it is the only one available if you want to build in 1/100th scale. A lot of correcting will have to be done if the finished product is to look right. As a collector's item, this kit now brings three to six dollars.

Ben F-104J, Kit Number A27

This is the same kit as released by Tamiya and reviewed above. It is a better value, because the decal sheet is much better in quality. It provides markings for two Japanese aircraft, 76-8692 and 46-8637. Collectors will usually pay from five to eight dollars for this kit.

Ben F-104G, Kit Number A28

Again, this is the same as the Tamiya and Ben kits described above when it comes to the plastic. The only differences are the box art and the decals. Markings are provided for German and Dutch F-104Gs, and are of good quality. This kit brings five to eight dollars from collectors.

RMM F-104G, Kit Number 22

The third company to issue this same 1/100th scale kit was RMM. A different box and new decals were the only changes made. Five German unit insignia and corresponding serial numbers allowed the modeler to choose from several Luftwaffe squadrons when marking this model.

Revell F-104G, Kit Number 4017

Revell also issued the Tamiya kit under their label and with their own decals. This time, USAF markings were included, but they were not of really high quality nor were they very complete. German and Dutch markings were also provided. This issue of the kit is the one that remains generally available, and it is not considered a collector's item.

1/96th Scale Kits

Aurora F-104, Kit Number 291

Only serious collectors would be interested in this kit, and it is valued in the six to ten dollar price range. This is a crude kit with engraved locations for the markings which represent YF-104A, 55-2956.

Marusan F-104, Kit Number 7067

This is another crude kit that has no value to serious modelers, and is worth only two to four dollars to collectors.

UPC F-104, Kit Number 7031

UPC re-released the Marusan kit under its own label, but made no changes other than to the box art. However, the box art is most interesting. It calls the aircraft an F-94 Starfire, but depicts an F-104 with Sidewinder missiles. The kit itself has no missiles, but provides tip tanks instead. Regardless, the kit only brings two to four dollars from only the most ardent collectors who just have to have one.

1/95th Scale Kit

Faller F-104G, Kit Number 1104

This off-scale kit is valued in the three to six dollar range in the collectors' guides, but we haven't seen one. Because of its odd scale and its unavailability, it is very doubtful that this kit would interest a serious modeler.

1/90th Scale Kits

Hasegawa F-104J, Kit Number D1

In Hasegawa's early days they offered several off-scale kits, and this was one example. Originally issued in 1960, this Starfighter was silver-plated plastic. It now brings from eight to twelve dollars on collectors' tables.

Hasegawa F-104J, Kit Number F1

This kit is identical to kit number D1 covered above. The only difference is that this one was not silver-plated. It is worth between six and ten dollars to collectors.

1/72nd Scale Kits

Airfix F-104G, Kit Number 291

The Airfix kit is probably the oldest Starfighter model in 1/72nd scale. It is quite crude, and has numerous shape problems. The canopy is too narrow and too much of a bubble. The intakes are also inaccurate in shape as are the tip tanks. The kit consists of thirty-six silver parts, with a one-piece clear canopy. These parts are not cleanly molded, and have rough edges and sink marks. Fit is also poor, with the worst area being where the aft fuselage mates to the forward fuselage. Decals are the one strong point, with nice German and Canadian markings being provided. With so many better kits of the Starfighter available in 1/72nd scale, this one would not interest the serious modeler.

Airfix F-104G, Kit Number 02011

This is a re-release of kit 291 covered above, and it is presently available. The comments made for kit 291 also apply to this issue.

MPC F-104G, Kit Number 2-2107

MPC released the Airfix kit under their own label in 1977. Markings were provided for a Luftwaffe aircraft coded JA+24. Otherwise, the kit itself was identical to the Airfix kits covered above. It has a collector's value of only two to four dollars.

MPC F-104G, Kit Number 1-4010

A second MPC release of the Airfix kit came in 1983, but except for a change in decals, the kit was the same as before. As with all of the Airfix and MPC releases, this kit cannot be considered by the scale modeler. It is also not considered a collector's item.

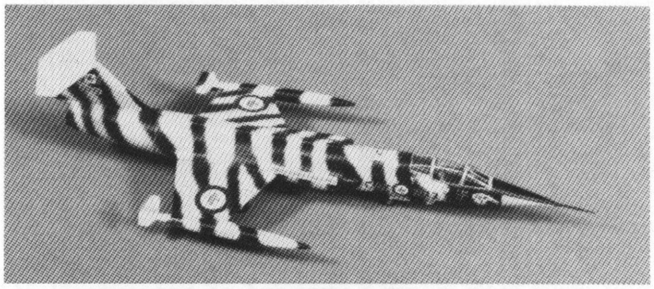
ESCI F-104, Kit Number 8243

This was the first of many releases of this 1/72nd scale Starfighter, and all releases are the same basic kit with different decals and box art. The color of the plastic used also varies, but otherwise the kit is usually identical from one release to another. These 1/72nd scale kits are far superior to the ESCI 1/48th scale kits covered later. A review of kit number 9013 is provided below, and generally applies to all of the ESCI kits. This first issue came with a comprehensive decal sheet which provided markings for German, Italian, Spanish, and Belgian aircraft.

ESCI F-104G, Kit Numbers 9007, 9013, 9037, and 9044

In 1986, ESCI made five different releases of its 1/72nd scale Starfighter kit. All are still generally available, and all are basically the same plastic as first issued in kit number 8243. Kit number 9037 does not have all of the ordnance options as the other kits. Otherwise, only the box art, decals, color of plastic used, and the instruction sheets are different. Kit number 9007 is for the F-104S and F-104G, and provides markings for five aircraft. These include two Italian, one Spanish, one German, and a Belgian aircraft. This is the same as had been included in kit 8243 covered above. Kit number 9011 has markings for an F-104C from Puerto Rico's Air National Guard, as well as two F-104Cs from the 479th TFW in natural metal finish. Kit number 9013 has Canadian markings used on an aircraft specially painted in a yellow and black scheme for the 1969 Tiger Meet, and a second set of markings is included for a Belgian Starfighter. Number 9037 has the "Red Baron" markings for N104RB, and is molded in red plastic. Kit 9044 is for a CF-104 with special Red Indian markings. Don Harris, a member of IPMS Atlanta built kit number 9013, and his comments apply to all of the ESCI releases.

The kit has finely scribed panel lines, and the fit is excellent. The landing gear and wheel wells have some detail in them, and the speed brakes may be left open if



Don Harris built the 1/72nd scale ESCI kit, and painted it in yellow and black tiger meet markings used by the RCAF.

desired. The cockpit is very basic with decals for the instrument panel and consoles. The seat that is provided is for the early Starfighters, and may not be correct for the specific aircraft being modeled. The canopy is one piece, but it is thin and clear.

There are plenty of extras in the way of fuel tanks, practice bomb dispensers, and Sidewinder missiles, so various ordnance loads and configurations can be attached to the model. The kit is simple and straightforward in assembly, and would be easy to build even for the beginning modeler. It is accurate in size, shape, and outline, and will enhance any collection. Its detailing is moderate, but can be enhanced by the modeler if desired. It is also very reasonably priced, and this is becoming a real consideration with many of today's models. We recommend this kit.

Heller F-104G/TF-104G, Kit Number 273

Heller was the first company to offer a Starfighter kit with the option of building a two-seat version of the F-104. Two different forward fuselage sections make this possible, and the modeler can choose between the single and two-seat versions from this one kit. This is unlike the Matchbox and Hasegawa kits described below where the modeler must buy a particular kit depending on whether he wants to build a single-seat or two-seat version. There are fifty-five parts to this kit, but not all will be used depending on which version is selected. Assembly requires some extra care to insure that parts line up right, and a fair amount of filling and sanding will be required where the fuselage sections mate and around the intakes. Fuel tanks for the wing tips and underwing pylons are provided, and these are the only external stores in the kit. However, Sidewinder missiles and other ordnance may be substituted from other kits or appropriate weapons sets.

Cockpit detailing is generally good, with raised gauges and switches being engraved into the instrument panels and consoles. There are control columns provided, but modelers will want to modify or change the seats to conform to the type used in the variant they are modeling. (See page 45.) The wheel wells lack detail, but this is not really noticeable. It is easily added if desired. Both canopies are the single-piece variety, but could be cut and opened to reveal detailing in the cockpit.

Four sets of decals are provided to allow the modeler to choose among German, Dutch, Belgian, or Danish markings. As with most Starfighter kits, it would be a simple matter to convert the tail to the smaller type used on the F-104A and F-104C, but this kit is probably best used to model a two-seat variant, and these all had the larger tail as supplied in the kit. We recommend this kit.

Matchbox F-104G, Kit Number PK 28

Molded in blue and white plastic, this kit is rather crude, and suffers from heavy engraved scribing that is common to many Matchbox kits. There are some shape problems, the most noticeable of which is the narrow canopy. Detailing is poor throughout, and the molding is not sharp and crisp. The only cockpit detailing is a pilot figure and a seat that resembles nothing that has ever been installed in a fighter aircraft. Decals are included for one German and one Canadian aircraft. Almost all of the 1/72nd scale kits that are now available are better than this one in several ways, so we cannot recommend this kit for the serious scale modeler.

Matchbox TF-104G, Kit Number PK 40

In 1986, Matchbox re-released its Starfighter kit with different fuselage parts so that a two-seat version could be built. It still has the fit, shape, detailing, and accuracy problems as the original kit, and the trench-like engraving remains on this issue as well. Its one redeeming value is that its decal sheet provides nice bi-centennial markings used on an F-104G from the 418th TFTS of the 58th TFTW at Luke AFB, Arizona. German Marine markings are also included on the sheet. If you want to build a two-seat variant of the F-104, we recommend the Heller and new Hasegawa kits as better choices.

Academy Minicraft F-104G, Kit Number 1619

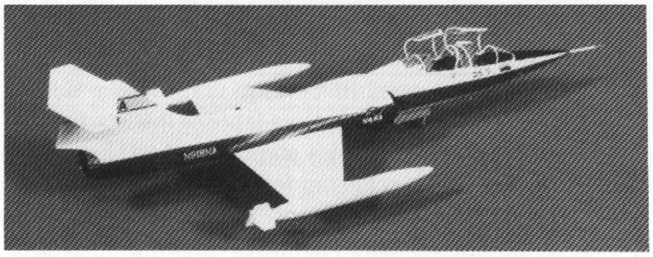
This kit is a rework, not a re-issue of the old Hasegawa 1/72nd scale kit covered below. Most, but certainly not all, of the parts are in the same positions on the sprue trees as they were with the original Hasegawa issue. But there have been some changes made, the most important of which is that this kit has engraved panel lines instead of the raised lines of the Hasegawa kit. But unfortunately, many of the problems with the old Hasegawa kit remain with this offering as well. These include an incorrect shape to the aft fuselage, an inaccurate canopy that has too much of a bubble shape to it, incorrect intake cones and cannon bulges, and a general lack of detailing. The cockpit is a one-piece affair, which has the seat, floor, and instrument panel molded together as it was in the Hasegawa kit. A crude pilot is provided as well. The speed brakes can be positioned in the open position, but there is no interior for them. It is therefore possible to see into one side of the aft fuselage and out the other.

As with the Hasegawa offering, there are four fuel tanks, fuselage-mounted Sidewinders, and a VICON camera pod provided as external stores. Decals are for a German Marine aircraft.

Hasegawa F-104J, Kit Number C3 (Old Series)

When covering the Hasegawa 1/72nd scale kits, it is most important to keep the old series of issues separate from the new series. The older kits are not very good, but the new ones are among the best 1/72nd scale kits available anywhere of any aircraft. We will first look at the old series of kits.

When issued, the original Hasegawa 1/72nd scale kit of the F-104 was probably the best in this popular scale that was available. But it still had many shape problems. The canopy was incorrect in shape, being too much of a bubble, and its rails were inaccurate. The intake cones were the wrong shape, and the aft fuselage was raised



One of the new Hasegawa kits was used by the author to build this NASA F-104 two-seater. This is a truly excellent kit, and could well be the best kit of the Starfighter in any scale. Several versions of this kit have been released allowing the modeler to build various versions, and even the detail differences between variants are provided.

Detail is excellent, with raised detailing on the instrument panel and consoles.

Options are provided to give the modeler choices with respect to the specific variant he is building. Both the Martin-Baker and C-2 upward ejection seats are included, as are the thin and thicker main gear wheels and tires. However, both sets of wheels have the spoked design instead of the holed design used on USAF aircraft. The instructions tell the modeler whether to leave on or remove antennas and other details on the model depending on the aircraft he is modeling. For all of the kits in this series, everything from ECM and RHAW antennas to extra pylons and fins are provided to allow the modeler to accurately finish his model. About the only options not yet provided are for F-104A and F-104C aircraft, but these could be modified fairly easily from one of the single-seat kits. All it would take would be to cut away the rudder from the larger vertical tail, then re-scribe a new one in the proper location. The inner fins on the tip tanks would also have to be modified for the U.S. aircraft as well.

The canopy for this kit is thin and clear, and comes in five separate sections. It is easy to display in the opened or closed position. The canopies in the other single-seat kits are likewise clear and thin. Other clear parts include lights for the nose and main gear struts, the gun sight glass, and lights that go around the aft fuselage and on each intake. These parts are extremely tiny, and require much care. The colored lights should be painted before they are removed from the tree. Finally, clear instrument panels are provided that have raised detailing. A careful and talented modeler can really detail these out nicely. But for others, the decals that are provided for the consoles and instrument panel may suffice.

Another nice feature of these kits is that there is a tail pipe, with the flame holder located well inside the fuselage rather than being near the nozzle as it is on so many other kits. In short, if you want to build a model of the F-104 in 1/72nd scale, these new Hasegawa models are the way to go, and in many ways they are even better than Hasegawa's large 1/32nd scale model. Markings in kit number 1004 include a TF-104G in USAF markings that belonged to the German Air Force at Luke AFB, two Japanese F-104DJs, and a Belgian TF-104G. However, we elected to use NASA markings on our review sample, building it to represent a NASA Starfighter that used to frequently pass through El Paso International Airport. Built out-of-the-box, the model is a beautiful addition to our collection. About the only thing many modelers would want to add would be some seat belts and buckles.

Hasegawa CF-104, Kit Number 1005 (New Series)

This kit is the same as the other single-seat releases in this new series, and provides markings for three Canadian Air Force Starfighters.

1/62nd Scale Kit

Comet F-104A, Kit Number PL500

Issued in 1955, this kit is quite crude by today's standards, and being in an "off scale," it has no value to the serious modeler. Collectors pay between three and six dollars if they are in the market for one.

1/64th Scale Kits

Revell F-104, Kit Number 251

First issued in 1957, this kit represented one of the early YF-104As, but Revell got a lot of mileage out of these molds, issued the kit many times with ground crew, Sidewinder missiles, and other minor differences. Usually, only the decals, box art, and instructions changed. The kit was rather primitive by today's standards. It had tip tanks of the design carried by the prototypes, and lacked any representation of the pitot probe. The pilot was molded into the seat, and this piece inserted into a hole in the lower fuselage, thus providing all of the cockpit detailing. Scribing for the control surfaces consisted of very simple engraved lines. The rest of the scribing was raised, and quite suspect when it came to accuracy. For example, the speed brakes were scribed into the lower fuselage half, but not the top half. There were no wheel wells, much less any wheel well detail, and the gear was crude at best. There was no fairing between the exhaust and the vertical tail. Many adult modelers of today will undoubtedly fondly remember using a tube of glue to assemble this kit in their childhood, but today, this original issue is of interest only to collectors who will pay between twenty and thirty dollars for one. It had the old Revell swiveling stand which also brings back memories to a lot of nostalgic "old timers" in this hobby.

Revell F-104, Kit Number H199

In 1958, Revell updated its kit from the previous year by deleting the tip tanks and replacing them with Sidewinder launch rails and missiles. A three-man ground crew was added, as was a rather bogus missile trailer. Today this is a collector's item that is valued between twelve and fifteen dollars.

Revell F-104, Kit Number G268

The third release of the Revell kit came in 1960, but this time it was part of a gift set that also included the F11F Tiger and F8U Crusader. The complete set is now worth forty to sixty dollars to collectors.

Revell F-104, Kit Number G290

A second gift set that included the Revell F-104 was issued in 1961, and it included the F-100, F-101, F-102, and F-105 Revell models as well. It is now bringing eighty dollars from collectors.

Revell F-104, Kit Number H142

Also in 1961, Revell re-released its F-104 model as a single kit in what it called its Air Power Series. Today, this kit is valued in the five to nine dollar price range.

Revell F-104, Kit Number H232

It was not until 1967 that Revell again issued its F-104 as a single kit. This time it was included in Revell's Jet Commando Series. Over the years the plastic remained the same, but by this time the molds were beginning to show some wear after being used for repeated releases. This kit is worth from five to nine dollars according to the collectors' guides.

AHM F-104, No Kit Number

AHM released the Revell kit under its own label with no changes to the plastic. Like all of the Revell kits, it reflects mid-1950's technology, and is quite crude by today's standards.

1/53rd Scale Kits

Otaki F-104J, No Kit Number

This unusual kit was molded in clear plastic and had a motorized nose gear to taxi the aircraft. A spoked fan produced a motor stand. In short, it was a glorified toy with no detailing and heavy rivets and panel lines. Collectors place its value in the twelve to fifteen dollar range.

Otaki F-104J, No Kit Number

Otaki issued the same kit covered above a second time, but in this release, silver plastic was used instead of the clear plastic found in the initial release. It too is only a collector's item, and not something that could be considered by the serious modeler.

Paramount F-104J, Kit Number 6104

Paramount released the Otaki kit under its own label with no changes except for the box art. It is only valued in the two to four dollar range by the collectors.

1/50th Scale Kits

Marusan F-104J, Kit Number 446

In 1960 Marusan issued this kit which is no longer available. It was not suitable for the scale modeler, and collectors will only pay from four to eight dollars for it.

UPC F-104J, Kit Number 5053

This is simply a re-release of the Marusan kit number 446 that was released under the UPC label. It too is valued in the four to eight dollar range, but it has no value to the serious modeler.

1/48th Scale Kits

Hawk F-104A, Kit Number 504-130

When Hawk released this kit the first time in 1960, it was the best quarter-scale kit available of the Starfighter. But it is very crude by today's standards, and should not be considered by the scale modeler. It was more of a toy, and had retracting landing gear. Positioning the speed brakes in the open position as shown on the instructions permitted a good view completely through the hollow aft fuselage. The kit consisted of forty-four pieces plus two pilot figures, a three-piece canopy, and a three-piece boarding ladder. There was no representation of the pitot probe. It is best left to the collectors who will pay between eight and twelve dollars for one.

Hawk F-104A, Kit Number 203-200

This kit was issued twice with the same kit number. The first time was in 1961, and the second release came in 1967. The box art was completely different, but the plastic and decals in the box were the same in both cases. Both releases were simply the same as kit 504-130 that is covered above, except the plastic was silver plated. As with the first release, these two issues of the Hawk kit cannot be considered by the serious modeler, especially when many better kits are available in this scale.

Testors (Hawk/Canada) F-104A, Kit Number 504

Issued in 1961, this kit was nothing but a reissue of the original Hawk kit. The only difference was the instruction sheet which was in both English and French. Collectors say its value is now in the eight to twelve dollar price range.

Testors F-104A, Kit Number 504

Again, the plastic is the same as the previous Hawk releases, but the decals are for the NASA aircraft N818NA.

Testors F-104C, Kit Number 592

This kit is currently available, and comes with the red comet markings used for a brief time by the 479th TFW. Otherwise, it is the same as previous issues of the Testors/Hawk kits.

Lindberg F-104, Kit Number 544

The first 1/48th scale kit of the Starfighter was this issue from Lindberg that was marketed in 1959. It consisted of fifty-two silver parts and a three-piece clear canopy. There were two bags of motorizing parts as well. The jet engine was designed to be removed from the aircraft and placed on its own stand. The ejection seat ejected downward. This kit has a five to nine dollar value to collector's but its inaccuracies and crude design make it unsuitable for the serious modeler.

Lindberg F-104, Kit Number 559

A second issue of the Lindberg kit offered NATO markings instead of those for the USAF, but the kit is still comprised of the same crude plastic representation of the Starfighter as the original issue. Let the collectors pay from five to nine dollars for it, but don't use it for model building.

Lindberg F-104, Kit Number 3104M

In 1968, Lindberg once again issued its same Starfighter kit a third time. This time it had German markings, but otherwise it was the same as before. Collectors will only give two to four dollars for one, and that is two to four dollars more than it is worth to the serious modeler.

Artidlast F-104, Kit Number 118

This is the Lindberg kit issued under a different label. Collectors report its value in the eight to twelve dollar price range.

Fuji F-104J, Kit Number 004-300

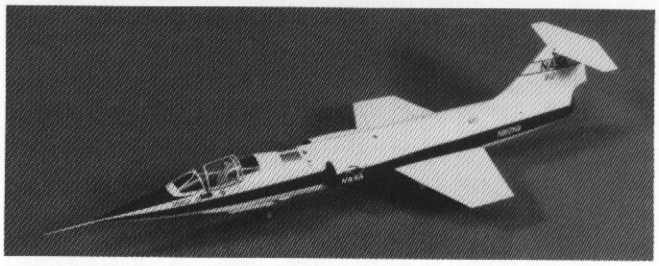
Issued in 1960, this is one of the earlier 1/48th scale kits of the Starfighter. There is a lot of Lindberg influence here, but there are sufficient changes to cause this kit to be treated separately. It has a working landing gear and other toy-like features, and is not suitable for the scale modeler. It is only valued between three and six dollars in the collectors' listings, and is worth even less to modelers.

Monogram F-104, Kit Number 5409

If you want to build a Starfighter in 1/48th scale, the Monogram kits are the ones to use. They are far superior to all of the other F-104 kits in this popular scale when it comes to molding, fit, accuracy, and detailing. This particular issue has the larger vertical tail used on foreign single-seat versions, and is best used for one of those variants or for a later NASA aircraft like Joe Driver, Jr. built as our review sample. But two other issues provide the smaller vertical tail used on the F-104A and F-104C versions. This kit provides the German Martin-Baker type ejection seat, while the F-104C kits also provide the C-2 upward ejection seat. A VICON camera pod is provided in all of the Monogram kits.

All of these kits include wing tip fuel tanks with the fin arrangement used on foreign aircraft. Two fuselage-mounted Sidewinders and launch rails are provided for armament, but the Sidewinders should be replaced with better ones from another kit. The aft door of the gun compartment can be displayed in the open position, but if this is done, the gun bay area will need some work to make it look better. The electronics bay behind the seat can also be shown with its cover open, and this is a nice feature.

The cockpit is detailed with raised instruments, switches, and knobs on the panel and consoles. The German seat is well done, and can be used effectively right out of the box. Some modelers will want to do some detailing to it, however. The canopy can be displayed in either the open or closed position effectively. Likewise, the landing gear is accurate and fairly well detailed. But again more detailing can be added. The main gear wheels are the spoked design used on the foreign aircraft. Other features include speed brakes that can be displayed in the open position revealing their wells and struts rather than a hollow fuselage.



The best of the 1/48th scale kits is from Monogram, and it was used by Joe Driver to build this model of one of NASA's Starfighters.

Construction is straightforward, and requires very little filling and sanding. The trickiest area of construction is lining up the tail piece with the forward fuselage. The afterburner can, which is attached to the forward fuselage, and the exhaust nozzle (part 12) make for a tight fit inside the tail section. There is a tendency for the tail piece to move while the glue sets. But all of the Monogram kits are better than any other in this scale, and we recommend them as the top choice for building a 1/48th scale model of the Starfighter.

Joe Driver, Jr., contributed to this review.

Monogram F-104C, Kit Number 5433

The first issue of the Monogram kit as a short-tailed version featured several changes over the original release covered immediately above. Naturally, the tail section of the fuselage was changed to represent the smaller vertical tail, but a new ejection seat was also included to represent the later (upward) USAF type. The Sidewinders were changed to an earlier version which appears to be the AIM-9B. These could be positioned on the wing tips or under the fuselage. Another important change was made to the main landing gear wheels which featured the holed design used on the F-104A and F-104C. The tip tanks were also included, but unfortunately, the fin arrangement was not the one used on USAF Starfighters.

Decals were for a natural metal aircraft with the red comet markings used by the 479th TFW, and for **SMOKE II,** a camouflaged aircraft from the same wing during a deployment to SEA. We used these decals on our Revell model covered below.

Monogram F-104C, Kit Number 5455

The third Monogram release was in their "Tour of Duty" series, and was the second to feature the short-tail versions of the Starfighter. This time both ejection seats of the previous kits are included, but the main gear reflects that used on the F-104A and F-104C. Decals are for F-104C, 56-0886, a bare metal Starfighter named **Fannie** that was deployed to Vietnam. Otherwise, the kit remains the same as 5433 covered above.

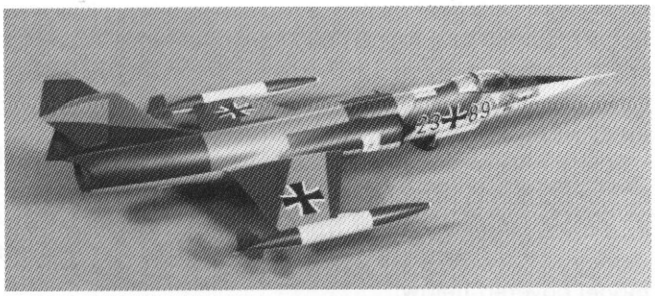
Monogram F-104J, Kit Number 5447

With this issue, Monogram returned to the larger vertical tail and spoked main gear wheels. The AIM-9B Sidewinders are provided as are both styles of ejection seats. Otherwise, the comments for the kits covered above apply to this one as well. The plastic is a bright yellow, and the markings are for the German Air Force's Buschel Canary.

Revell F-104, Kit Number H-236

Parts are provided to build either the small or large-tailed single-seat Starfighters, however, the problem is that nothing fits. Everywhere there is a need for filling and sanding, and construction becomes a frustrating exercise in assembling plastic. The parts are not crisply molded either, and everything seems to have rounded edges. Detailing ranges from fair to bad, depending on where you look. For example, the flame holder is less than an inch inside the exhaust nozzle, when it should be positioned well inside of the tail section. The cockpit is fair, and features raised detailing on the instrument panel and consoles. The seat is also fair, but all of the cockpit will need some work. The landing gear is average, but there is no detailing in the wells, and the wheels represent the spoked design of the foreign variants. Further, the tip tanks have only the fin arrangement used on foreign versions, so they must be modified if a USAF aircraft is to be represented. The entire gun bay can be shown opened up, but here again, most modelers will want to add a little extra work on their own. Sidewinder missiles can be mounted on either the wing tips or fuselage locations. Decals provide markings for a bare metal F-104C from the 479th TFW and an F-104G of the German Air Force.

With its rather serious fit and molding problems, we cannot recommend this in view of the fact that the Monogram kits are far superior and are offered at a reasonable price.



The Revell 1/48th scale kit can be built as a short-tailed F-104A or -C or as the larger-tailed, single-seat variants. The author built the F-104A from the Revell kit, while Jim Whitley built the German F-104G.

Revell (Germany) F-104G, Kit Number H-261

Revell of Germany issued the same kit as covered above for the European market. It is considered a collector's item valued between eight and twelve dollars.

ESCI F-104, Kit Number 4004

Generally speaking, the ESCI 1/48th scale kits of the Starfighter are better than the Revell but not as good as the Monogram in quality, accuracy, and detailing. This first issue originally had a horrible canopy with bumps molded into the clear plastic, but this was later corrected. This issue featured options to build several aircraft with the larger vertical tail.

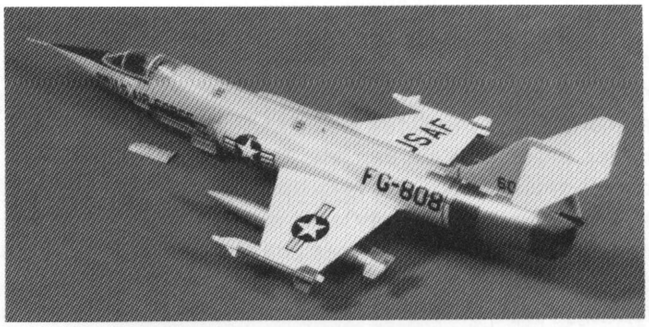
The detailing is rather sparse, and the fit is not good because of the few pins and holes with which to line the parts up. The refueling probe is so inaccurate at the nozzle end as to make it unusable. The pylons for the wings are incorrect in shape, and the missiles leave a lot to be desired. In the cockpit, the details are supplied only by decals, and the seat does not really accurately represent any seat used in the F-104. The landing gear fares a little better, but there is a lack of detailing in the wells. The main gear wheels are of the spoked design. Both the gun bay and the speed brakes can be shown in the open position, but here again, detailing will be required.

Tip tanks, Sidewinders, Sparrows (for the F-104S), and a practice bomb dispenser are included as external stores. The decal sheet provides markings for USAF, Canadian, Italian, Greek, and Spanish aircraft. But overall the kit simply is not that good, and it will take considerable effort to build it into an accurate and well-executed model.

ESCI F-104C, Kit Number 4013

This issue of the ESCI kit was similar to the first, but featured the smaller vertical tail and rudder. Otherwise, the comments provided above also apply to this kit when it comes to the plastic.

Decals were supplied for three F-104Cs. One was a bare metal F-104C from the 479th TFW, and the second was from the same unit except that it was painted in the standard camouflage scheme. The third aircraft was from the Puerto Rico Air National Guard.



The ESCI 1/48th scale kit is better than the one from Revell, but not as good as the one from Monogram. This is an ESCI kit that was built by the author as an F-104A.

1/32nd Scale Kits

Hasegawa F-104C, Kit Number 104

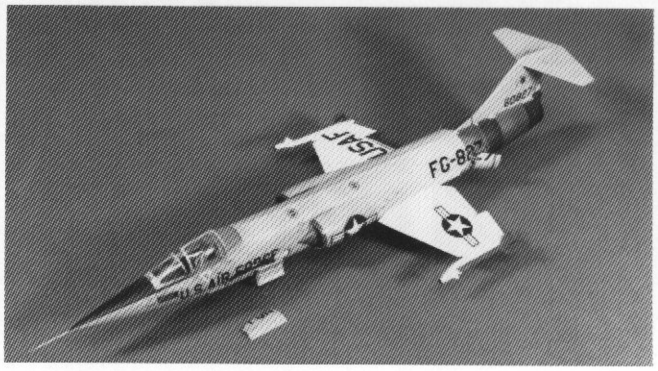
Although this kit has the smaller vertical tail and rudder of the F-104A and F-104C, it shares several other parts with kit S1 (covered next) that are applicable only to the foreign aircraft. These include the spoked type wheels and the fin arrangement on the fuel tanks that were used on the foreign variants. The fins on the tanks can be modified to the correct design, or the tanks can be left off entirely, so this problem is not too bad. However, the incorrect wheels are noticeable in this scale, and the only way we know of to correct this problem is to build new ones from scratch. Further, the radar is the type used in the F-104J, not the one used in the F-104A or F-104C, so it too cannot be used.

Otherwise, the kit is excellent. The fit is quite good, and requires little filling and sanding. The gun bay can be shown opened up or closed depending on the desires of the modeler, and the same is true of the speed brakes. The cockpit interior is detailed with raised instruments, knobs, and switches, but the seat will require some extra detailing. Most important is that seat belts and buckles should be added.

A complete engine is supplied, but it really isn't well detailed for one this size, so it is best to simply enclose it in the fuselage and glue the fore and aft sections together. The landing gear struts are nice, and the main strut has a metal wire that fits inside it to provide the necessary strength to support the large model. But the wheel wells lack detail, and this should be added to a model this size.

The decal sheet provides markings for Col. George Laven's colorful aircraft when he was the commanding officer of the 479th TFW. However, only the most basic markings are provided, and the smaller stenciling is not included.

Overall, this is a good kit, and we recommend it. It is unfortunate that Hasegawa did not go all the way in truly representing an F-104C, but a patient and skilled modeler can still turn this kit into a real masterpiece.



The large Hasegawa 1/32nd scale kit was built by the author to produce this model of an F-104A from the 319th FIS. It is an excellent kit with superb detailing everywhere except the cockpit.

Hasegawa F-104J/G, Kit Number S1

Most of the comments for kit number 104 above also apply to this kit as well. However, in this issue, Hasegawa supplied the larger vertical tail surfaces that were used on the foreign variants. The spoked wheels, tank fins, and radar are all appropriate for the F-104J. Otherwise, the kit is identical to the one above. Decals provide markings for a Japanese F-104J and a German F-104G. However, if the German aircraft is selected, the proper ejection seat will have to be built from scratch.

Revell (Germany) F-104C/G, Kit Number 4722

This kit consists of ninety-two pieces of gray plastic and a one-piece clear canopy. Five landing and position lights as well as the gunsight glass are also molded in clear plastic. The tires are molded in rubber, and choices are provided to allow for the appropriate option between the F-104C and -G versions. Detailing in the cockpit is supplied by decals, which really is not acceptable to most modelers who work in this scale. The ejection seat is a crude one-piece affair. There is no engine provided, and it is possible to see in the intakes and out the exhausts. This is something that might be expected in a kit from the 1950s, but not from one that was issued in 1982 as this one was. Overall, we think the Hasegawa kit is the better choice in 1/32nd scale.

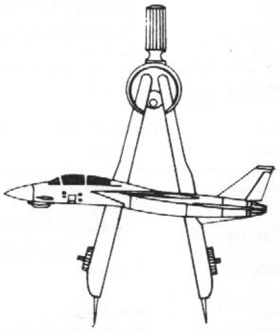
DECAL LISTING

Manufacturer and Sheet Number	Scale	Type	Nationality	Unit	Scheme	Remarks
Superscale 72-88	1/72	F-104G	German	JABO G 31	Std. Ger. Camo	Includes national insignia and all small stenciling
		RF-104G	German	AG 52	Std. Ger. Camo	
		F-104G	German	MFG 2	Std. Ger. Camo	
		TF-104G	German	WsLw 10	Std. Ger. Camo	
Superscale 72-180	1/72	F-104G	USA	NASA	White and two shades of blue	Includes small stencils but no national insignia
		TF-104G	German/USA	418th TFTS		
		TF-104G	USA	Lockheed	Natural Metal	Lockheed demonstrator
Superscale 72-181	1/72	F-104G	Greece	NA	USAF Std. Camo	
		F-104A	Jordan	NA	Natural Metal	
		F-104G	Turkey	4th FW	Overall Gray	Square Turkish National Insignia
		F-104G	Turkey	141 Sqn.	Natural Metal	Roundel Turkish National Insignia
		F-104G	Nat. China	NA	Overall Gray	
		F-104G	Nat. China	NA	USAF Std. Camo	

Superscale 72-340	1/72	F-104G	USA	NASA	White and two shades of blue	Includes small stencils and national insignia
		F-104A	USA	56th FIS	Natural Metal	
		F-104A	USA	83rd FIS	Natural Metal	
		F-104A	USA	337th FIS	Natural Metal	
		F-104A	USA	319th FIS	ADC Gray	
		F-104A	USA	331st FIS	ADC Gray	
Superscale 72-358	1/72	F-104C	USA	479th TFW	Natural Metal	Col. George Laven's aircraft named "REALLY GEORGE?" while he was CO of 479th TFW
Superscale 48-43	1/48	Provides markings for same six aircraft as sheet 72-340 above, however, this sheet is in 1/48th scale, and has no national insignia or stencils.				
Superscale 48-245	1/48	F-104G	Germany	JG-34	Special	25th anniversary black, red, and yellow scheme
		CF-104	Canada	421 Sqn.	Special	25th anniversary overall red scheme
Superscale 32-40	1/32	F-104A	USA	NASA	White and two shades of blue	NASA N818NA
		F-104A	USA	83rd FIS	Natural Metal	
		F-104A	USA	337th FIS	Natural Metal	
Maintrack Models Twin-Seat Special No sheet number	1/72	TF-104G	Belgium	No. 1 Wing	USAF Std. Camo	
		CF-104D	Canada	NA	Natural Metal	
		CF-104D	Canada	AETE	Green/Gray Camouflage	
		TF-104G	German	MFG 2	Std. Ger. Camo	
		TF-104G	German	WS10	Std. Ger. Camo	
		TF-104G	Norway	NA	Olive & Gray Camouflage	
		TF-104G	Spain	ALA-10	Natural Metal	
		TF-104G	Greece	336 Sqn.	USAF Std. Camo	
		F-104D	USAF	436th TFS	Natural Metal	
Maintrack Models Twin-Seat Special No Sheet Number	1/48	This sheet provides markings for the same nine aircraft as the 1/72nd sheet immediately above except that the markings are in 1/48th scale.				
Tauro Model Torino 72-538	1/72	Provides Italian national insignia for various aircraft to include F-104 Starfighters.				
Tauro Model Torino 72-518	1/72	Provides serial and aircraft numbers for various Italian aircraft to include F-104 Starfighters.				
Tauro Model Torino 72-520	1/72	Provides various unit insignia for Italian Air Force squadrons to include 12 F-104 units.				
Tauro Model Torino 72-523	1/72	Provides A.M.I. Anniversary markings for several Italian aircraft to include one F-104S of an unspecified unit.				
Tauro Model Torino 48-519	1/48	Provides serial and aircraft numbers for various Italian aircraft to include F-104 Starfighters.				
Tauro Model Torino 32-509	1/32	Provides various unit insignia for Italian Air Force squadrons to include five F-104 units.				
Tauro Model Torino 32-516	1/32	Provides serial and aircraft numbers for various Italian aircraft to include F-104s.				
Tauro Model Torino 32-521	1/32	Provides various unit insignia for Italian Air Force squadrons to include 11 F-104 units.				
Tauro Model Torino 32-529	1/32	Provides serial and aircraft numbers for various Italian aircraft to include F-104 Starfighters.				
Tauro Model Torino 32-537	1/32	Provides serial and aircraft numbers for various Italian aircraft to include F-104 Starfighters.				
Tauro Model Torino 32-538	1/32	Provides serial and aircraft numbers for various Italian aircraft to include F-104 Starfighters.				

NOTES:

1. This listing is based on generally available decals as of February 1991. Other sheets have been available in the past, but are no longer on the market.
2. Decals listed under the Superscale label were formerly marketed under the Microscale name, and in many cases they still are available under the old name.
3. The Tauro Model Torino decals from Italy are unusual. To do a single aircraft, the modeler must buy a sheet of unit insignia, another of aircraft numbers, and a third of national insignia.



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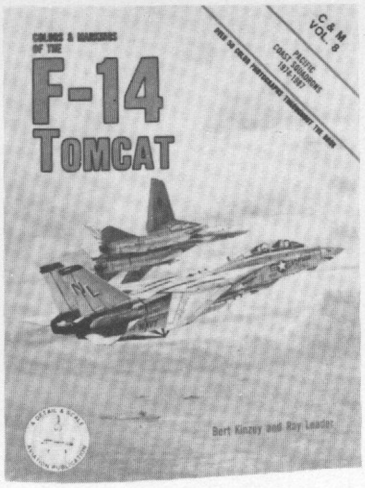

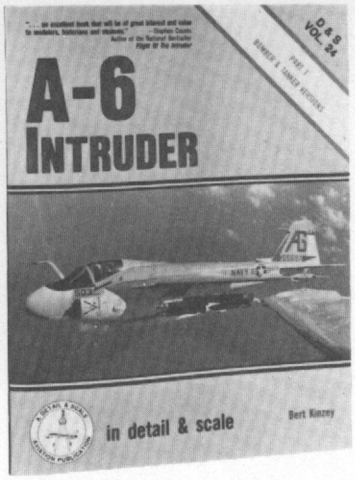

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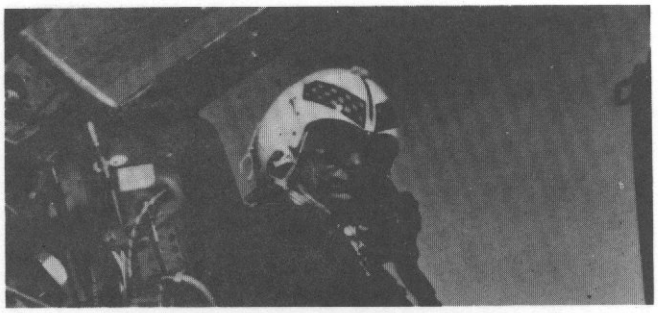
ABOUT THE AUTHOR


The author in the rear seat of an F-5F after returning from a Red Flag mission.

Bert Kinzey, author and president of Detail & Scale, Inc., was born in Richmond, Virginia in 1945. The following year his family moved to Blacksburg, Virginia where his father became a professor of architecture at Virginia Tech (VPI). Until he was about six years old, Bert was often frightened by the loud piston-driven military fighters that sometimes flew low over his home while he was outside playing. On more than one occasion he came running into the house extremely frightened by an aircraft that had just flown over.

His father took him to the VPI airport, where cadets were learning to fly on J-3 Piper Cubs, and arranged for him to go for a flight. Bert sat on his father's lap for a short trip around Blacksburg, and that forever ended his fear of airplanes. Later, Bert's father built a balsa and tissue model of the J-3 Cub, and Bert's interest in modeling began.

Bert's fear of aircraft soon gave way to a love of aviation, and he began scale modeling. Bert looked at modeling (and still does) not as a hobby in and of itself, but as a small facet of his overall interest in aviation.

In 1959 his family moved to Gainesville, Florida, where his aviation interest took second place to his trumpet playing in high school. In 1964, he graduated from P.K. Yonge High School and returned to Virginia Tech specifically to fulfill his lifetime dream to be in the Virginia Tech Regimental Band—The "Highty Tighties."

Upon graduation he was commissioned a second lieutenant in the Army, and he spent almost eight years as an army officer. During this time he commanded a Hawk guided missile battery in Korea and later wrote and taught classes in airpower, the Soviet air threat, and air defense suppression at the Army's Air Defense School at Ft. Bliss, Texas.

In August 1976, he resigned from active duty in the Army, but his reputation as being knowledgeable in all aspects of military airpower led to a job offer as a civilian with the Department of the Army. He served in this position for four years as a "subject matter expert" in military airpower and was responsible for the development of the Army's new program on aircraft identification, the first in the world to feature dynamic simulation. During this time he started Detail & Scale as a part-time business to provide detailed reference material on military aircraft.

Detail & Scale became so successful that Bert resigned from his position with the Army to devote full time to his new company. Since then he has written several books as well as articles for several magazines. He is also an avid modeler and member of the International Plastic Modelers Society (IPMS). In July 1982, he was presented with a special award by IPMS/USA in recognition for his contributions to the society. He is also a member of the American Aviation Historical Society, and the Aviation and Space Writers Association.

As a youngster who feared airplanes, it is ironic that Bert should now be so involved with aviation. He is a licensed pilot, and lives with his wife, Lynda, and their two children, Jan and Chip, in Peachtree City, Georgia, near Atlanta.

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